WORLD'S POULTRY SCIENCE JOURNAL

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Official Organ of the
WORLD'S POULTRY SCIENCE ASSOCIATION

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WORLD'S POULTRY SCIENCE JOURNAL

Volume 16 April-June Number 2

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R. GEORGE JAAP
Ohio State University, 674 West Lane Avenue, Columbus 10 Ohio, U.S.A.

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XIIth POULTRY SCIENCE CONGRESS IN AUSTRALIA

August 10-18, 1962

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GOLDEN JUBILEE OF WORLD POULTRY SCIENCE ASSOCIATION

The 12th World's Poultry Congress to be held in Australia, August 10-18, 1962, should prove to be one of the greatest international agricultural science events of the year.

This Congress will have special significance because it will mark the 50th anniversary of the World's Poultry Science Association.

In view of the many worldwide changes which are currently taking place within the poultry industry it would seem logical to expect a sharp interest and active participation. Announced organization of strong Australian Congress committees is good evidence that our Australian hosts will maintain the high standards of previous Congresses and that they intend to see to it that every delegate will have both a worthwhile and enjoyable time.

Upon first thought, Australia seems many, many miles away, but by 1962 it is bound to be many hours closer. Then too, the old saying "distance lends enchantment" is bound to work in favor of a good attendance.

The big dates to be remembered and to plan for are August 10-18, 1962.

H. H. Alp
President of W.P.S.A.

The first official notice from "Down Under" respecting the XIIth Poultry Science Congress in Australia in 1962, has recently been issued. The dates have been confirmed as August 10th to 18th. The meetings will be held at Sydney in the famous show grounds of the Royal Agricultural Society of New South Wales.

This twelfth Congress will mark the Golden Jubilee of the W.P.S.A. which held its first meeting in London in 1912.

Sessions of the Congress will follow the usual pattern and will comprise Genetics and Breeding, Physiology and Nutrition, Diseases, Economics and Marketing, and Husbandry and Miscellaneous.

Several official appointments have been made. They include the Minister for Primary Industry as President; Mr. J. V. Moroney, O.B.E., Secretary of the Department of Primary Industry, Chairman; and Mr. R. C. Blake, Chairman of the Australian Egg Board, Vice-Chairman.

A full Executive Committee has been appointed and pictured are some of its members who met in Sydney recently. They are (clockwise) Messrs. A. O. Moll, H. O. Murray, R. C. Blake (Vice-Chairman), A. S. Wotton, W. D. Hardy, J. V. Moroney, O.B.E. (Chairman), P. F. Butler, F. H. Skaller, R. H. Rule, Prof T. J. Robinson (proxy for Prof. S. H. Roberts), and Messrs. R. Donnelly and G. Edgar (proxy for Mr. E. O. Tout).

The announcement on the preceding page that the XIIth World Poultry Congress will be held in Sydney, Australia, at the "Showgrounds" of the Royal Agricultural Society of New South Wales, will no doubt be of interest to those associated with the poultry industry throughout the world.

This, the Congress in the Jubilee Year of the W.P.S.A. will be the first held in Australia and, in fact, the first held in the Southern Hemisphere. That the Australians are determined that this Congress will be a landmark in the history of

the Association is evidenced by the fact that an executive committee has already been formed and includes leading personalities in the Australian industry. Sub-committees also have been formed and are already at work on details.

Sydney Showground from the air, with the Grand Parade of livestock in progress. More than a million people visit the Show each year.

The "Showground" in Sydney where the Congress will be held could really be called a "showpiece" as far as Sydney is concerned. During the Royal Show each year in Sydney over a million people attend the show. The grounds cover an area of 71 acres and the five main exhibition buildings have a total area of a quarter million square feet.

It is proposed that the Congress will utilise the Commemorative Building (pictured) as a registration centre and Exhibition Hall with the Arts and Crafts Hall as an overflow for the exhibition and a lecture hall. Four other smaller lecture halls are being arranged, some of which are provided with projectors.

The Arts and Crafts Pavilion (pictured) covering an area of 35,000 square feet was built in 1956 on the design of a leading French architect M. Maurice Gauthier.

The handsome Commemorative Pavilion (45,000 sq. ft.) at Sydney Showground, where the Royal Easter Show is held each year. The five main exhibition buildings have a total area of 225,000 sq. ft.

The Arts and Crafts Pavilion at Sydney Showground. The two-storey pavilion has an area of 35,000 sq. ft.

Delegates to the Congress will have parking facilities inside the grounds for 3,000 cars and other facilities have provided for 15,000 cars outside.

As practically the whole of the Congress will take place at the Showground in buildings within easy reach of each other, arrangements are being made for Congress Club Rooms and Dining Rooms at the Showground itself.

The Showground is within easy reach of the city and delegates in most cases can reach it within ten minutes of the main city hotels.

The photograph of the Showgrounds from the air shows the Commemorative Pavilion in the left background, while the building in the middle background is the Poultry Pavilion, where the Poultry Exhibition will be held.

POULTRY BREEDERS OF AMERICA

The Poultry Breeders of America is a "Not for Profit" corporation organized to include interested poultry breeders in North and South America. The major purposes of the corporation as stated in its Articles of Incorporation are:

To foster, promote and improve the general welfare of those interested in the poultry breeding industry by providing a vehicle through which group action may be taken on matters of common concern:

(1) By providing forums through which members may exchange views on solutions of various problems of specific and general interest to the poultry breeding industry and its related branches.

(2) By promoting and encouraging scientific research projects of benefit to the poultry breeding industry.

(3) by encouraging public testing of poultry stocks.

(4) By disseminating to its members and others in the poultry breeding industry educational and economic information of particular value and interest to them.

(5) By striving to improve the standards of quality of poultry stock generally.

The annual active membership dues of the Poultry Breeders of America is $100.00 per year which are payable in advance on the first day of July in each year.

Further information may be obtained from the Secretary-Treasurer:

Mr. Don M. Turnbull
521 East 63rd Street
Kansas City 10, Missouri, U.S.A.

DR. M. A. JULL

Dr. M. A. Jull for many years was one of the most active and effective members of the World's Poultry Science Association. When the World's Poultry Science Journal was established in 1945, Dr. Jull served as chairman of its publication committee. Dr. Jull contributed signed articles to early numbers of the Journal designed to stimulate reader interest and contributions. These included one in 1945, volume 1: 52, "Bringing International Poultry Statistics Up to Date," which described the void left by the lapse of the International Yearbook of Agricultural Statistics, which in prewar years had included such statistics.

Dr. Jull's emphasis on this problem was followed by inclusion of such data in the Production Yearbook of FAO and the recognition of the World's Poultry Science Association by FAO.

Dr. Jull contributed a second article in 1945, volume 1: 92-93, discussing the possible assumption of abstracting service by the World's Poultry Science Journal, pointing out that such service might preclude some popular and informational articles in the Journal.

Since 1945, Dr. Jull has been a principal contributor to the World's Poultry Science Journal. He has kept before its worldwide audience information on poultry and poultry problems in every corner of the globe.

Dr. Jull's activity in World's Poultry Science Association affairs began many years prior to the establishment of World's Poultry Science Journal. He participated in the Third World's Poultry Congress in Ottawa in 1927, the Fourth in London in 1930, the Seventh in the United States in 1939, and the Eighth in Copenhagen in 1948. He was a member of the Council of the World's Poultry Science Association in the thirties, and contributed many abstracts to the old International Review of Poultry Science, then the official publication of the Association.

Dr. Jull was a prime mover in the preparations for the Sixth World's Poultry Congress in Germany in 1936 and the United States exhibit there was prepared under his direction.

Dr. Jull arranged for a splendid pre-Congress meeting for foreign delegates to the Seventh Congress at the University of Maryland and was most active in preparations for the very successful Cleveland meetings and exhibits of that Congress.

Dr. Jull's constructive thinking, hard work and leadership have been a major factor in the growth of the World's Poultry Science Association, its Journal and its Congresses.

T. C. Byerly

THE CHICK IN NUTRITIONAL RESEARCH

JACOB BIELY

Poultry Nutrition Laboratory
The University of British Columbia, Vancouver, Canada

Fundamental and applied research in poultry nutrition is being vigorously pursued in government, University and industrial laboratories in every province and state on this continent and in many other countries. In Canada and the United States over 100 laboratories are working on different poultry nutrition problems. Findings in related fields of study on a wide variety of animals have an important bearing on the research work that is being carried out with poultry. Scientific journals, conferences and symposia all contribute to a steady flow and exchange of information among investigators.

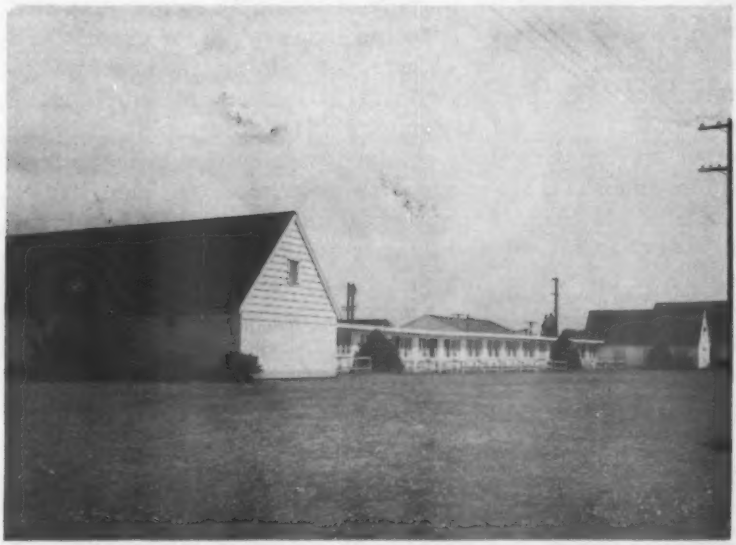
Research in nutrition has markedly influenced the economy of the poultry industry. The improvement in feeds that has taken place in the past decade can be described as being almost fantastic. Many old notions have been discarded and new concepts developed. Not so many years ago it was believed that chickens could not tolerate fat. Today, we know that chicks will thrive on rations containing 30% or more of fat. The vitamin B complex of dried milk by-products which at one time was considered to be an essential part of the ration for growing chicks and breeders can be replaced by synthetic vitamins or fermentation products. Feed efficiency in regard to egg and meat production has been increased by 25 and 50%, respectively, as compared with a decade ago.

Concomitant with the above changes there has also been a steady improvement in the health of flocks through the use of drugs, antibiotics and other additives.

In recent years the formulation of poultry rations has been placed on a scientific basis. The various components are fitted in together like the parts of a "jigsaw puzzle". The more we learn the more complex we find the puzzle to be. The nutritional "jigsaw puzzle" is still far from being solved completely.

Scientific feeding has made possible the year round production of eggs and poultry meats. The ups and downs of seasonal production have been practically eliminated. This

has led to greater efficiency and more economic production of poultry products. Today, families even in the low income group can enjoy and afford the consumption of eggs and poultry meats. In fact, at today's prices poultry meat and eggs are among the cheapest protective foods available.



Poultry nutrition buildings in which chickens are reared and kept in confinement. Note the sunporches to which birds have access throughout the year.

THE CHICK IN SCIENTIFIC INVESTIGATIONS

It may be said that the scientific era in poultry nutrition began in the early 1920's, when it was demonstrated that chicks could be reared indoors when their ration was supplemented with cod liver oil and that laying birds kept in confinement could produce eggs with sound egg shells when the ration contained this ingredient. The beneficial effects of cod liver oil were demonstrated to be due to its vitamin D content. This vitamin is required for proper utilization of calcium and phosphorous. The skeleton of the bird consists mainly of calcium and phosphorous while the shell of the eggs is mainly of calcium. It is now well known that in the absence of vitamin D or its equivalent, sunlight, chicks develop rickets and laying birds produce soft-shelled or shell-less eggs.

The discovery of vitamin D has enabled scientists to initi-

ate experimental work under controlled environmental conditions by rearing chicks indoors on the floor or in wire cages. Since 1922 the chick has become an experimental tool in the hands of poultry nutritionists as well as being of value to scientists in other fields of study. Some of the experiments are carried out for the purpose of obtaining information that would be of direct value to the industry; other experiments are pursued with the object of obtaining fundamental information in connection with various aspects of nutrition and still others are used to compare the findings obtained with other species with those obtained with chicks. Perhaps from a fundamental point of view the most important contribution made by the chick in the field of nutrition was its role in the discovery of the different forms of Vitamin D and the elucidation of the nature of rickets. Whereas experimental rickets in the rat can be induced only when the ratio of calcium to phosphorous is greatly disturbed, in the chick, rickets can be produced when the ratio of calcium to phosphorous is normal. Furthermore, rats can utilize D_2 and D_3; chicks respond only to D_3.

Poultry nutrition building in which New Hampshires have been reared and bred for six generations in confinement.

The multiple nature of what used to be known as vitamin B has been expedited through simultaneous research with both rats and chicks.

The mystery of the biotin-avidin complex was solved through the chicks. The so-called egg white injury of chicks could be prevented by the use of biotin or by destroying the avidin with heat.

Much of the experimental work that led to the discovery of folic acid and particularly vitamin B_{12} has been carried out with chicks.

In the protein field it is interesting to note that, while the rat requires ten essential amino acids for growth, the chick requires at least 12 dietary amino acids for rapid growth. Turkey poults require much greater amounts of the essential amino acids than do chicks. Poults fed a ration borderline in lysine will develop feathers which lack normal pigmentation, characterized by a distinct white bar across the wing feathers. This syndrome is interesting because it is one of the few instances in which a deficiency of an amino acid causes a distinct symptom other than poor growth.

In chicks an isoleucine deficiency sometimes manifests itself in a typical curled tongue. Not enough is known yet, however, about the effects produced by individual amino acids, aside from retared growth, poor feed utilization and eventual death.

Chicks respond very quickly to nutritional deficiencies or imbalances, whether of organic or inorganic nature. Specific symptoms may occur within two to three weeks after the chicks are placed on the experimental diets or even under practical conditions.

PARENTAL NUTRITION

The response of chicks to an experimental diet may be markedly influenced by the diet which has been fed to the parental stock. In the case of vitamins and certain minerals the rations fed to breeders may have an important bearing on the progress and outcome of the experiment in question.

In discussing vitamin reserve, intake and deficiency in the young chick Almquist writes as follows:

> "Deficiency states in young chicks are most likely to become apparent during a critical period of the appropriate second and third week of life. The transference of vitamins from the maternal diet can be an influential factor during this life period of the chick. The reserve store in the chicks is a safety factor which tides the chick over an early period until vitamin intake from diet can be built up to meet requirements. Intake must not be hampered by delayed feedings, incomplete diets or stresses which interfere with feed consumption and utilization".

The length of time chicks will survive on a vitamin A deficient diet will depend upon the vitamin A content of the breeder ration. In experiments carried out at the Washington

Experiment Station the livability of chicks hatched from hens receiving different amounts of vitamin A in the diet varied on the average from 7.3 to 44.7 days. Thus in planning vitamin A studies with chicks it is essential to control the vitamin A content of the breeder ration.

Community cages for laying birds (15-20 birds per cage)

In laying birds vitamin A has a profound physiological effect on reproduction. Recent work at Washington has shown that the incidence of blood and meat spots can be considerably reduced if liberal amounts of vitamin A are fed, i.e., in excess of that required for optimum egg production and normal health.

For a number of years it has been realized that vitamin E spares vitamin A. It is now known that this property of vitamin E can be taken over by synthetic antioxidants. When vitamin A is protected against destruction by light, air, moisture or rancid oil the vitamin A needs of chicks and laying birds are considerably less than the hitherto recommended levels.

The effects of certain vitamin deficiencies in the maternal diet may not necessarily show up immediately in the percentage of hatchable eggs or in the condition of the chicks at time of hatching. This has been illustrated rather strikingly in connection with vitamin E requirements of turkeys. During the first two months of egg production turkeys fed conventional types of breeder rations will produce hatching eggs that hatch at a normal rate. However, as the season advances hatchability begins to decrease gradually and eventually be-

comes so low that it is not economical to produce late hatch poults. It has been reported that a marked drop in hatchability occurs after approximately the fortieth egg has been laid. If, however, the breeder ration is fortified with vitamin E, hatchability is maintained at normal levels. Apparently the vitamin E reserves of the breeder hen are being gradually depleted because of insufficient amounts of vitamin E in the breeder diet. However, when the ration is fortified with vitamin E the vitamin E level in the eggs is maintained and as a consequence, normal hatchability is maintained during a prolonged hatching period. It has been noted that turkey embryos from hens fed vitamin E deficient diets show degenerative changes in the eye.

Aside from ensuring normal hatchability vitamin E performs a number of other vital functions such as prevention of nutritional encephalomalacia, exudative diathesis, and muscular dystrophy in chicks; enlarged hocks and muscular dystrophy of the gizzard muscle in turkeys and ducks. Vitamin E is essential for the prevention of permanent testicular degeneration in male chicks.

Exudative diathesis and muscular dystrophy can be prevented by inclusion of vitamin E in the diet. However, work carried out simultaneously at several laboratories indicates that these two conditions can be prevented by selenium. Recent studies show that there might be a close metabolic interrelationship between selenium and vitamin E so that both of them might be functioning to meet the same basic need. It seems that the requirements for vitamin E and selenium are indeed distinct and separate although they may be quantitatively inter-related.

MINERAL CARRYOVER

An even more striking illustration of the importance of adequate nutrition for normal hatchability is offered in the case of a mineral deficiency, namely, manganese. The story of maganese in the role of body metabolism is an interesting one, not only in so far as chickens are concerned but in all domestic animals as well.

Breeder hens fed a ration deficient in maganese will produce hatching eggs with a low manganese content. As a result of the low manganese content a number of characteristic malformations will take place in the developing embryo. The

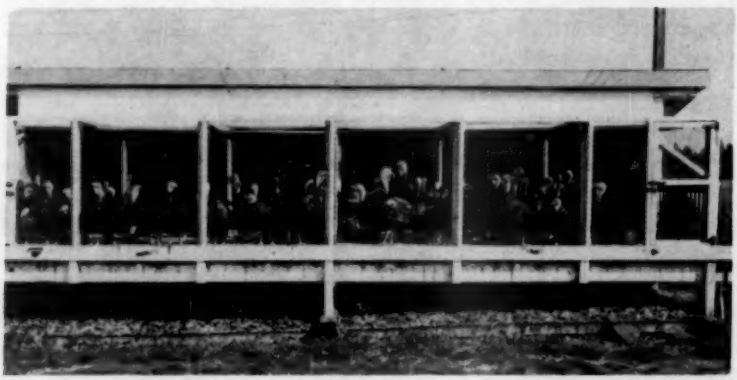
condition has been described as chondrodystrophy and is associated with a low percentage of hatchability. The chicks that do hatch appear to be quite normal although lacking somewhat in vitality. When placed on ordinary chick diets they are prone to develop perosis or slipped tendon. In fact it is not unusual to find day-old chicks showing perosis at the time they hatch out.

Perosis in chicks results primarily from a mineral imbalance of calcium phosphorous and manganese but may also be induced by deficiencies or imbalance of at least six vitamins of the B complex and certain amino acids imbalances.

HOCK DISEASE IN TURKEYS

The far reaching effects of good nutrition during the early stages of growth and subsequent development or performance can be illustrated through studies carried out with hock disease in turkeys.

This abnormal condition may occur in turkeys during early stages of development (six to ten weeks of age) as well as after growth has been nearly completed. It is characterized by slight deformity of the hock joints, resulting in a stilted gait, impaired movement, and disinclination to eat. Eventually the birds have to be destroyed. There has been and still is a great deal of confusion regarding the exact cause or causes of hock disease. Fast growing birds are generally more subject to it than slowly developing birds; male birds are more prone to it than females; birds reared on wire floors are more



The University of British Columbia turkey shelter with slatted floor. Five generations of turkeys have been bred in the above shelters.

likely to suffer from hock disease than birds reared on the floor or having access to range. A number of factors are implicated, namely a proper balance of calcium to phosphorous, adequate manganese, several water-soluble vitamins and vitamin E. Zinc was recently implicated as a factor and there may be other factors involved.

Hock disease is thus an external manifestation of a metabolic disturbance caused by a deficiency, excess or improper balance, of several nutritional factors. The problem of hock disease provides a challenge to the specialist in intermediate metabolism and enzymology.

ISOTOPES

The test of a good breeder ration is the percentage of hatchable eggs and viable chicks that it will produce. As a general rule, to ensure good hatchability, breeders are fed specially fortified rations for at least 30 days efore eggs are collected for incubation. Justification for this long established practice has been recently furnished in the work carried out at the University of Saskatchewan. It was shown by O'Neil that radiophosphorous P^{32} fed to a laying hen on a given date was still appearing in the eggs a month later. "At this time, the phosphorous must have been coming from the muscles and the bones. This possibility was confirmed by an analysis of the left tibia of the bird which 40 days after feeding showed about seven percent of the phosphorous fed."

It was further found that "Labelled calcium in the replaceable skeletal calcium" approaches a maximum after 26 days of feeding the Ca^{45} in the calcium supplement, or in other words the skeletal calcium is replaced with new calcium in approximately 26 days.

Atomic energy is helping to reveal basic biological processes by finding the path of certain tracers through tissues of eggs or chickens, as well as by recording changes in metabolism not readily measurable by other means. Biochemical transformations within the egg have been studied by this means at U.S.D.A., Beltsville, Maryland. Included are conversions of methionine to cystine and some of it to taurine or sulphate. The sulphate produced is believed necessary for the formation of cartilage.

Tracer studies also showed that chickens up to six weeks old depend largely on the egg supply of vitamin B_{12}. Later

they manufacture a part of their requirements of this vitamin.

It has recently been shown also that radioactive sulphur from methionine was more rapidly deposited in hens on a low protein diet than in those on a normal diet. Contrary to previous concepts it would appear that chicks have a requirement for sulphur *per se*, which may be satisfied by either providing methionine and cystine in excess of that required for protein formation, or by means of sulphates. "When the methionine and cystine content of the diet was somewhat deficient it was found that sulphate exerted a sparing effect upon these amino acids. The results of the studies showed that the utilization of sulphate sulphur for the synthesis of either methionine or cystine is too small to be of any nutritional significance in the chicken. Radioactive sulphate sulphur^{35} was used in the experiments to plot the metabolic pathways followed by sulphur." In further work Machlin *et al* (J. Biol. Chem. 212: 469-475) were unable to detect any radioactive sulphate sulphur in the sulphur containing amino acids of newly hatched chicks from eggs injected with this sulphur isotope.

MICROBIAL SYNTHESIS

The chief function of dietary carbohydrates is, of course, to supply energy to the body in a readily available form. Recent work indicates that the nature of carbohydrate supplied to the chick may have an important bearing on the intestinal microflora and thus indirectly on the well-being and performance of the chick.

It may not be amiss to mention here the early work of Metchnikoff who believed that man's life could be prolonged if the bacteria which are ordinarily present in the intestinal tract could be displaced by lactic acid organisms. As far back as 1900 Rettger advocated that chicks which were infected with *Salmonella pullorum*, the causative agent of pullorum disease, should be fed skim milk instead of water. He believed that the lactose in the milk would modify the bacterial flora in the gut and thus help to suppress the pathogenic organisms responsible for the pullorum disease.

That there is a close connection between health and the normal microbial habitants of the intestinal tract has been accepted by students of nutrition and the medical profession. In this connection we may quote Pasteur who speculated as follows.

"Often in our laboratory discussions for the last several years I have told the young research workers in my group that there should be much interest in raising young animals such as rabbits, guinea pigs, dogs and chicks from birth on pure food materials. By this latter expression I refer to food products which have been freed completely from common microbes by laboratory methods. Without wishing to speak positively, I wish to state that I would undertake this investigation if I had time with the expectation that life under these conditions would become impossible. By such an approach one could perhaps attempt to study the digestive process by the systematic addition of microbe-free nutritive materials or single strains of microbes or mixed cultures of known microbes. The egg of the chicken lends itself without serious difficulty to this type of experiment. The outside of the shell could be kept free from bacteria at the moment the chick hatched and then the chick could be placed in a germ-free environment ventilated by sterile air, and sterile food (water, milk and grains) could readily be introduced from the outside. Whether the results would be positive and would confirm the preconceived idea which I have put forward or whether it would be negative or even reversed, that is to say that life under these conditions would be actually stimulated, it would be of great interest to try such an experiment."*

We know today that the microflora contributes importantly to the nutritional economy through the synthesis of vitamins. Certain vitamins, such as biotin, folic acid, and vitamin K can, under reasonable circumstances, be synthesized in adequate amounts by the intestinal flora. Experimental demonstration of this phenomenon has been brought forward recently. When a synthetic diet containing sucrose, was fed to chickens the biotin content of the yolk dropped from 510 to 48 mc./gm. and of the albumen from 65 to 15 mc./gm. When dextrin was included in the ration instead of sucrose there was a significant increase in the biotin content of the eggs and the hatchability of the eggs was superior to that produced on a sucrose diet. The difference in the biotin content of the eggs and the hatchability would appear to be due to differences in microbial synthesis of biotin induced by the two sugars.

There is considerable evidence now that bacterial synthesis plays an important indirect role in the nutrition of animals. Some of the critical vitamins appear to be synthesized in the intestinal tract in sufficient amounts for normal health. However, under stress or some artifically created situation the vitamins must be supplied in the diet. This is well exempli-

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* Jukes, T. H. 1955. Antibiotics in Nutrition. Medical Encyclopedia, Inc., New York 22, N. Y.

fied in the case of two widely divergent vitamins, viz., vitamins K and B_{12}.

VITAMIN K

In the attempt to obtain rapid growth and efficient utilization on low cost rations a number of radical changes have been made in modern type poultry rations. The so-called high energy ration generally contains a minimum amount of dehydrated green feed (a good source of vitamin K) because it is high in fiber. The major protein concentrate used in high energy rations is soybean oil meal. It is low in vitamin K because it is processed by solvent extraction. A coccidiostat and an antibiotic are generally included in broiler rations. It has been shown that such rations may be borderline in vitamin K and, as a result, the chicks may suffer from a hemorrhagic condition. Apparently, the kind and number of bacteria present in the intestinal tract of the growing chick are unable to synthesize sufficient vitamin K to overcome a dietary deficiency. It has been found advantageous under those conditions to supplement the ration with a synthetic source of vitamin K.

Certain other stress conditions may aggravate the need for dietary vitamin K; hence the reason for considering vitamin K as a dietary essential, whereas a number of years ago it was purely of academic interest to the poultry nutritionists.

VITAMIN B_{12}

A further illustration of the interaction that exists between nutrition and bacterial synthesis in the intestinal tract is offered by vitamin B_{12}. This vitamin is essential for normal metabolism when an all-vegetable ration is fed to breeders and growing chicks. It plays a somewhat less important role in egg production. This vitamin is required in a few parts per billion as contrasted with other vitamins which are required in comparatively much larger amounts. Vitamin B_{12} is involved in many metabolic reactions involving protein, vitamin, mineral and fat inter-relationships. It is not present to any extent in vegetable products. Fish and meat products and by-products are good sources of this vitamin. However, chicks fed on an all-vegetable diet unsupplemented with vitamin B_{12} will apparently thrive, provided they have access to their droppings. The bacteria present in the droppings and litter, particularly deep litter, synthesize vitamin B_{12} to meet the ordinary needs of growing chicks. The same applies to

adult breeding stock. When breeders are kept on wire, however, so as to minimize contact with droppings the body reserves become depleted of vitamin B_{12}, the eggs do not hatch well, while the chicks that do hatch show typical deficiencies associated with a lack of vitamin B_{12}.

Vitamin B_{12} contains cobalt as part of its molecule. When a cobalt salt is included in the ration the bacteria which are present in the gastro-intestinal tract are able to synthesize vitamin B_{12} and thus make the chick independent of dietary sources of this vitamin. From a practical point vitamin B_{12} probably requires the least attention since it is readily synthesized in the intestinal tract or spared by other nutrients.

ANTIBIOTICS

The interdependence of host, diet and environment has been forced to our attention through the use of antibiotics, arsenicals, furazones and other additives. Antibiotics, when added to a poultry ration may stimulate growth by as much as 10 to 15 percent. The stimulus to faster growth occurs apparently during the first week or two of the chick's life. The impulse, however, is carried over for somewhat longer periods of time. The mode of action of antibiotics can be explained in a number of different ways. It is generally accepted that the main action is through the effect the antibiotics have on the bacteria present in the intestinal tract in which the chicks are reared.

A newly hatched chick to all intents and purposes may be considered as being free from bacteria. But just as soon as it is removed from the incubator it becomes exposed to bacterial infection. It is not very long before the chick becomes contaminated with desirable or undesirable bacteria as the case may be. The elimination of subclinical infection through feeding antibiotics at low levels results in healthier chicks and a more salubrious environment. (Vide the work of Libby and Schaible, 1955 Science Vol. 121, No. 3151.)

Proof that this is so has come from another source. When chicks are reared in an environment where no chicks have ever been reared before they do not, as a general rule, respond to antibiotics. In the absence of infection antibiotics do not exert consistent or substantial effects. They do, however, produce a lesser but nevertheless a beneficial effect through better assimilation of feed.

Canadian investigators have shown that under experimental conditions antibiotics may enhance the absorption of calcium, phosphorous and manganese. The greater absorption of minerals is apparently mediated through changes in the pH content of the small intestine produced by the antibiotics or, as suggested by some workers, through a reduction in the thickness of the intestinal wall.

ENERGY CONTENT OF RATIONS

Perhaps one of the most interesting developments that has taken place recently is related to carbohydrate content of poultry rations and dietary enzymes.

Work carried out in Washington indicates that barley, which supplies 875 calories of productive energy per lb. as compared with corn which supplies 1,110 calories per lb. can be made comparable to corn in energy. This is done by the addition of special enzymes which release the energy locked up in the starch of barley. Other grains respond to a somewhat lesser degree than barley. Further, not all barleys respond in the same manner. Many details have as yet to be worked out. However, the fundamental principle has been established that the energy content of grains and grain by-products can be released when a suitable enzyme is added. Perhaps through the action of appropriate enzymes many vegetable wastes may be rendered useful as feeds for poultry.

FAT AND CHOLESTEROL

It has already been stated that contrary to former beliefs chickens can tolerate large amounts of fat and oil in the ration. It has been recently established that fats and oils, aside from contributing calories in a concentrated form, are able to promote growth beyond their theoretical caloric content. Apparently fats and oils contain some unknown beneficial substance, or in some indirect way may improve or enhance the utilization of other nutrients in the ration, thus improving growth and feed utilization. Thus fats may be said to spare other nutrients, resulting in better utilization of the ration.

From both a practical and a fundamental point of view the poultry nutritionist is very much concerned with the effect of different fats on body metabolism. High fat rations fed to adult birds cause fatty livers, fatty infiltrations around the kidneys and excessive accumulation of abdominal fat.

Generally these conditions result in excessive mortality. Of particular interest to the nutritionist is the increase in plasma lipids and cholesterol which may result when high levels of fats are fed. The type of fat and the protein level of the diet have an important bearing on the extent to which dietary fat influences plasma cholesterol.

MISCELLANEOUS FACTORS

There are indications in the literature that a number of unidentified or uncharacterized growth-promoting factors are present in natural feeds. Some feedstuffs contain certain factors which interfere with the best utilization of feed for growth, production and hatchability. As examples, one might mention such growth inhibitors as those present in raw soybean, saponin in alfalfa, selenium in wheat grown in North Dakota and Wyoming, and goitrogenic substances in rape seed meal.

Aside from diet there are a large number of factors which may affect the chick's nutritional requirements. These may be genetical, physiological and physical. To date, most of the nutritional requirements have been established with one or two breeds or strains of birds under more or less ideal experimental conditions. To what extent nutrient requirements are modified in disease, high or low temperatures, with or without artificial light, etc. remains yet to be worked out.

NUTRITIONAL INTER-RELATIONSHIPS

The trend in nutrition research in the past has been largely concerned with the study of the role and mode of action of individual nutrients. The present approach is that of a study of nutritional balance and of an interrelationship between nutrients. The interelationships between tryptophane and niacine, methionine and cystine, phenylalanine and tyrosine, choline and labile methyl donors, vitamin B_{12} and fat, energy and methionine may be mentioned as examples. There is currently a great deal of interest in mineral interelationship. The absolute and relative requirements of each of the essential minerals are now being reinvestigated in detail.

There are now something like 50 known nutrients that are necessary for normal body metabolism. It is hoped that some day we shall be able to strike a perfect balance.

We have gone a long way on the road of developing synthetic diets and yet there are indications that though

almost perfect, they can frequently be improved when a natural product is included in them. Natural feeds apparently contain certain as yet intangible substances which are required for the normal metabolic functions of animals.

As far back as 1906 Sir Gowland Hopkins stated:

> "but further, no animal can live upon a mixture of pure protein, fat and carbohydrate, and even when the necessary inorganic material is carefully supplied, the animal still cannot flourish. The animal body is adjusted to live either upon plant tissues or other animals, and these contain countless substances other than the proteins, carbohydrates and fats. Physiological evolution, I believe, has made some of these well nigh as essential as are the basal constituents of the diet; lecithin, for instance, has been repeatedly shown to have a marked influence upon nutrition, and this just happens to be something familiar, and a substance which happens to have been tried. The field is almost unexplored, only it is certain that there are many minor factors in all diets, of which the body takes account."

Although a half a century has elapsed since Sir Gowland Hopkins made the above observations there is still an endless number of unsolved problems in nutrition. Just recently it has been shown that zinc, molybdenum, bromine, and selenium have significant nutritional roles. No one can predict what important and exciting nutritional discoveries will be made during the next 25 years. Certain it is that no young scientist need feel discouraged about future opportunities in nutrition research.

RESEARCH IS REWARDING

One of the most rewarding aspects of poultry research is that practical use is made of many of the new findings by the poultry industry. Thus, the results of the research work carried out by a large number of investigators in government and private laboratories benefit the public at large. Today, eggs and poultry meats have become the most readily available foods on the continent and will soon become equally as available in underdeveloped countries. Compared with other foods, eggs and poultry have not risen in price as have other basic foods, the increased costs of production having been absorbed through more efficient management.

Eggs and poultry meat play an important role in promoting better food habits. Wholesome balanced diets are essential for the promotion of "positive health". By preventing malnutrition and undernutrition resistance to certain diseases may be increased. The poultry industry is playing an important part in providing food for the growing world's population, both in terms of quantity as well as quality.

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AMBIENT ENVIRONMENTAL CONDITIONS ASSOCIATED WITH REPORTED SPONTANEOUS OCCURRENCE OF THERMAL DEATH IN POULTRY[1]

ROBERT L. SQUIBB and GERALD N. WOGAN

Department of Poultry Science, Rutgers, The State University of New Jersey, New Brunswick

The effects of high environmental temperature on poultry have been studied from several aspects, e.g., egg production, egg quality, size, growth and mortality. Numerous studies at a variety of geographic locations have suggested that high environmental temperature is responsible for the annual summer decline in egg production. Joiner and Huston (1957) have demonstrated depression of growth rate in 3 breeds of chicks maintained at 90°F from hatching time to 10 weeks of age. Squibb (1958) failed to observe adverse effects of high environmental temperature and humidity on egg production or livability of poultry housed in 5 distinct climatic zones in a tropical area. As a suggested explanation for the lack of effect in these studies, a working hypothesis of environmental conditions which constitute thermal stress in poultry was proposed. Maximum stress would be imposed when (a) diurnal temperature range narrows as mean temperature departs in either direction from approximately 72°F; and (b) when there is a sudden change in temperature in either direction from that to which the animals have become conditioned.

While poultry may withstand high temperature extremes in summer months, situations have been reported wherein such temperatures have not only depressed growth and egg production but also have caused extensive mortality. These adverse effects occurred despite the fact that observed maximums failed to reach record highs for the given area. In two studies of mortality of fowls in heat waves in the northeastern United States, Hutt (1938) and Fox (1951) have suggested that the danger of heat death is present when maximum temperature reaches 100°F.

In the studies described here, estimates of total losses were derived from daily and trade newspaper articles which

[1] Paper of the Journal Series, New Jersey Agricultural Experiment Station, Rutgers, The State University of New Jersey, Department of Poultry Science, New Brunswick, New Jersey.

were based, in most instances, upon interviews with agricultural agents or others directly concerned with the poultry or livestock industry. Climatological data were obtained from official U. S. Weather Bureau records[2] from field stations in and around the areas where heavy mortality was observed. Associations made, therefore, represent the summation of effects of the general environment on poultry and disregard such factors as the climate and microclimate within poultry houses, management practices and breeds. These and other similar factors must obviously be evaluated by controlled experimentation. The purpose of the present paper is to point out the importance of environmental parameters in evaluation and prediction of spontaneously occurring thermal death under practical conditions.

The various areas, dates and estimated mortality losses are summarized in Table 1. Daily minimum and maximum temperatures for each of the areas are presented in Figs. 1, 2 and 3. In each figure the graphs to the left present data for a short period preceding the thermal stress in addition to the critical period itself. The graphs on the right contain similar data for the corresponding period in 1957, a year during which no unusual mortality was reported. The latter data are included for comparison in order to illustrate more clearly possible patterns of environmental temperature which constitute serious thermal stress.

Comparison of wind movement and humidity for each of the areas during the periods of extreme thermal stress with those recorded during the reference year 1957 indicated similar patterns. Observed maximum and minimum ambient temperatures at the time of extreme mortality showed marked differences or trends between years for each locality.

The first incidence of heavy mortality from heat stress to be considered took place in the Los Angeles-San Diego area of California in the period August 31-September 5, 1955. As shown in Fig. 1, the incidence of mortality coincided with a sudden rise of daily maximum temperature of 20°F (83°-103°) in one day (Aug. 30-31) in the Los Angeles area, and a similar sharp increase (77°-97°) in the San Diego area. Simultaneously, there occurred a less marked rise in minimum temperature in both cases, with concomitant increases in

[2] Supplied by National Weather Records Center, Asheville, N. C.

TABLE I

Three areas reporting unusual mortality in poultry due to thermal stress

Dates	Area	Estimated losses	Type of bird	Information source*
	West Coast			
Aug. 31 - Sept. 5, 1955	San Diego Co., Calif.	300,000	Chickens, turkeys	Oakland Tribune, Sept. 2, 1955 Santa Ana Register. Sept. 3. 1955
	Orange Co., Calif.	250,000	Chickens	Los Angeles Times, Sept. 4, 1955
	Los Angeles Co., Calif.	Mass burials necessary		Riverside Daily Press, Sept. 24, 1955
	Eastern States			
June 23 - July 1, 1952	Delmarva Peninsula	200,000	Layers, broilers	Vineland, N. J., Poultryman, July 4, 1952
	Cumberland Co., N. J.	95,000	Layers	
	Ocean & Monmouth Co., N. J.	50,000	Layers	
	Salisbury, Md.	20,000	Layers	
	Whiton, Md.	5,000	Layers	
	Bridgewater, Mass.	10,000	Small roasters	
	Midwest			
July 11-17, 1954	Portions of Missouri, Kansas Oklahoma and Arkansas, e.g., northwest Arkansas	"Unprecedented in two decades" 750,000	Broilers, breeders, turkeys	Poultry & Eggs Weekly, July 16 & 23, 1954; Hatchery News, Vol. 30, No. 12, Aug., 1954

* Courtesy of Dr. W. O. Wilson, Dept. of Poultry Husbandry, University of California, Davis, Calif.

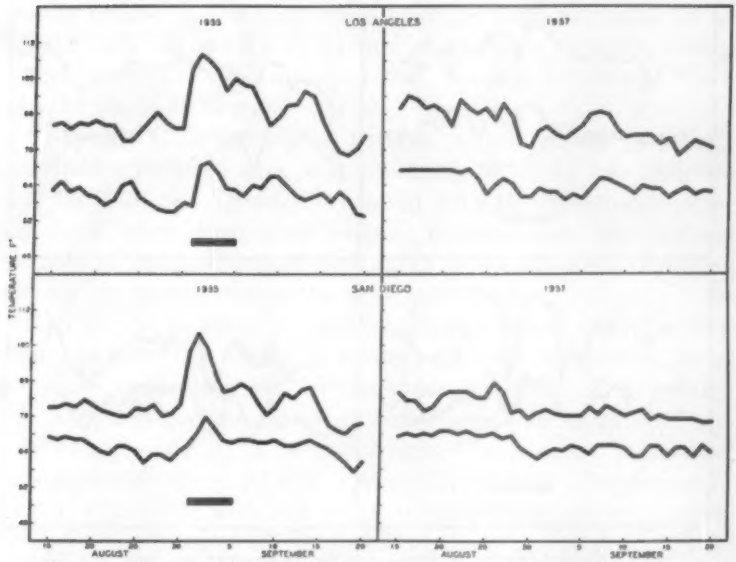

Fig. 1. Comparative diurnal temperature ranges for the Los Angeles-San Diego area for 1955 (left graph) and 1957 (right graph) with the periods of mortality indicated by a horizontal bar.

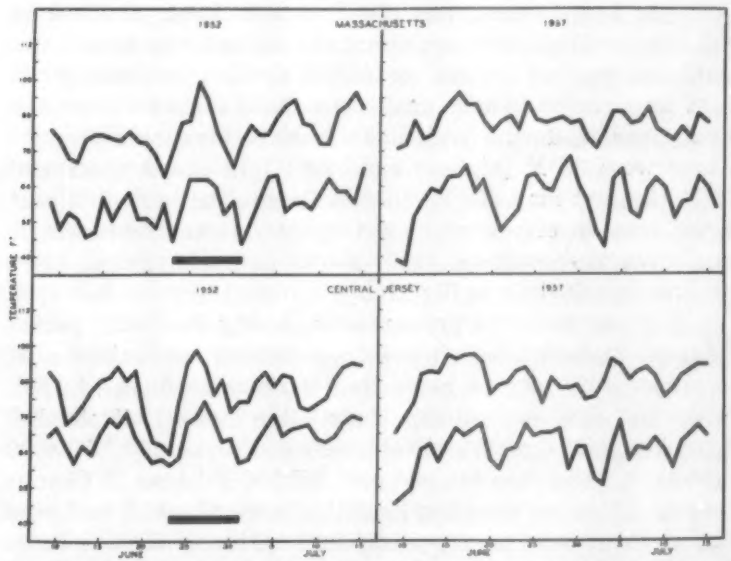

Fig. 2. Comparative diurnal temperature ranges for the Massachusetts, Central Jersey area for 1952 (left graph) and 1957 (right graph) with the periods of mortality indicated by a horizontal bar.

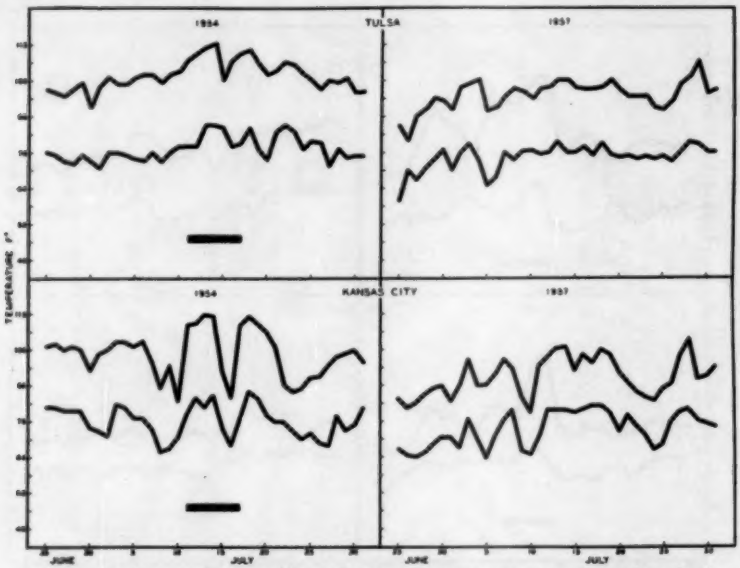

Fig. 3. Comparative diurnal temperature ranges for the Tulsa, Kansas City area for 1954 (left graph) and 1957 (right graph) with the periods of mortality indicated by a horizontal bar.

diurnal ranges. On the following day, further increases to 110°F in Los Angeles and 104°F in San Diego resulted in still heavier losses, and represent the highest maximum temperatures reached during the period under consideration. It is of importance to note that these sudden rises followed a 30-day period during which the average maximum temperatures were 85°F (highest max. 89°F) in Los Angeles and 78°F (highest max. 83°F) in San Diego. The period of heat stress was, in effect, prolonged by only minor decreases of maximum temperatures (110°-106°F in Los Angeles; 104°-99°F in San Diego) on September 2.

Reports from the general area during the 4-day period (August 31-September 3) are fragmentary, but estimates of total mortality may be made from surveys conducted in San Diego and Orange Counties. Cumulative losses to September 3 were estimated at 300,000 chickens and turkeys and 250,000 rabbits in San Diego County, and 250,000 chickens in Orange County. Other surrounding localities, some of which had even higher temperatures, reported losses so heavy that recourse to procedures of mass burial was necessary to dispose of dead animals. A final survey in Orange County conducted some 2

weeks following the heat wave revealed that mortality averaged 11.5% (range 0.2-41%) in 65 cases. It is significant that losses were greatest among older, heavier birds and were smaller in light breeds.

By the fifth day of the thermal stress period (Sept. 4), maximum temperatures had fallen to 95°F in Los Angeles and 85°F in San Diego. Correlated with the diminished temperature were decreasing reports of mortality. No further periods of thermal stress leading to mortality were observed during the remainder of the month.

It is of interest to contrast temperature data for the year 1957, during which no sudden marked increases of temperature were observed. In the same 2 months of this year, the highest maximum temperatures observed were 95°F in Los Angeles and 85°F in San Diego. The average maximum temperatures were 86.9°F (August), 82.5°F (September), 79.6°F (August), and 76.5°F (September) for the two areas, respectively. In spite of the fact that these values are slightly higher than those for 1955 (excluding periods of excessive heat), no mortality related to heat stress was reported.

Because of similar temperature patterns, it seems appropriate to consider next the incidence of thermal stress in a different goegraphic locale, viz., on the eastern seaboard during the period June 23-July 1, 1952. Although mortality was reported from various localities (Table 1), weather data from New Jersey and Massachusetts are typical and will be presented in detail.

In both areas a remarkable sequence of temperature changes occurred the week preceding the period of thermal stress. During the period June 19-23, maximum temperatures decreased sharply from 91°F to 63°F in New Jersey, with a smaller decline in Massachusetts (82°-67°). Concurrently, there was a less marked decrease in minimum temperatures (Fig. 2), with a resultant narrowing of the diurnal range. The weather pattern associated with the reported mortality consisted of a very sharp increase in maximum temperatures from 63°F, June 23, to 98°F, June 26 (New Jersey) and 67°F to 98°F (Massachusetts) in the respective areas. Mortality records (table 1) reveal that severe losses were reported on June 25-26, i.e., on those days when maximum temperatures were attained for the period.

Again, although reports are fragmentary, estimated losses amounted to 200,000 chickens (mixed layers and broilers) in the Delaware-Maryland-Virginia (Delmarva) peninsula; 150,000 layers in Central Jersey; and smaller losses of roasters in Massachusetts. One authoritative report alleged that deaths in the Delmarva area began at 5:00 P.M., June 25 when a "mild breeze died" and that greatest losses were seen in areas where "woods or shrubs blocked air movement."

The importance of the prevailing conditions which caused the mortality is emphasized by comparison with the corresponding period of 1957, during which time unusual incidence of mortality was not reported. In both areas the maximum temperatures reached were 95°F (Massachusetts) and 97°F (New Jersey), essentially the same as those related to mortality in 1952. The patterns by which these maxima were reached, however, are entirely different.

The third incident to be considered involved portions of Missouri, Kansas, Oklahoma and Arkansas and took place during the period July 11-17, 1954. Weather data from the Kansas City and Tulsa areas are presented in Fig. 3. In this case, still another temperature pattern was responsible for thermal stress. In the Kansas City area, a very sharp rise in maximum temperature (83-109°F) occurred on July 10-11; two days later, 112°F was attained. These changes followed an abrupt decrease (103-82°F) during the preceding 5 days (cf. New Jersey data). After four successive days of temperatures above 106°F (July 11-14), a second abrupt decrease was observed (111-84°F), which was again followed by a sharp increase (84-111°F) in two days.

The data of Tulsa show a somewhat different pattern. Although the period of mortality was the same as in Kansas City, conditions preceding the thermal stress are quite different. In this case, maximum temperatures had hovered about 100°F for some 10 days prior to reported mortality. The precipitating conditions appear to be a gradual increase in temperature from 103°F (July 10) to 112°F (July 14). Therefore a decrease-increase pattern similar to (although less dramatic) the Kansas City data was evidenced.

Mortality reports from Arkansas are assumed to be representative of the area. A survey of 20 dealers and hatcheries placed estimated losses on July 12-13 at 750,000 broilers,

turkeys and breeding hens. In circumscribed areas, losses totalled 2,500-5,000 birds per house; turkey losses were particularly heavy. Losses of this magnitude were "unprecedented in two decades."

Comparison of these data with those of the corresponding period in 1957 allows two observations: absolute maximum temperatures approached but did not reach those observed in 1954; and conditions shown to have precipitated thermal stress leading to mortality failed to appear. It should be noted that the period of mortality in 1954 was preceded by a 30-day drought, a point which will have importance subsequently.

DISCUSSION

The temperature extremes which an animal can tolerate depend upon a complex series of relationships. Important factors are: (a) species, or in the present case, breeds within a species; (b) the environmental temperature to which the individuals have become acclimated during the period being considered; and (c) length of exposure to extreme temperature (Allee, Emerson, Park, Park and Schmidt, 1949).

Certain of these factors are ecological expressions of the degree of acclimatization. In any animal species, the limits of acclimatization are determined genetically, although they may be altered by natural or artificial selection. Hutt (1938) demonstrated that White Leghorns were more tolerant too high temperature than either Rhode Island Reds or White Plymouth Rocks. Lee *et al.* (1945) reached similar conclusions when White Leghorns were compared with Australorps and Rhode Island Reds.

Superior tolerance in lighter animals is generally attributed to more efficient heat loss due to a larger surface area: weight ratio. These observations are in keeping with the principle of Bergmann which correlates surface area: weight ratio with geographic localization of various species. Allee and Lutherman (1940), in studying the influence of rearing temperature on pullets, demonstrated that animals raised at low temperature were heavier and had smaller surface area:weight ratios. In the present data (Table 1), it has been noted that mortality was uniformly greater in heavier birds and in larger animals (turkeys).

The observations of Lee *et al.* (1945) and Fox (1951), however, suggest that behavioral pattern may play a more

important role than body weight in the differential tolerance between light and heavy breeds. Both authors note the tendency of the White Leghorn to consume greater quantities of water during exposure to high temperature than the heavier breeds. This behavior pattern is heritable (Fox, 1951) and may represent a form of genetic acclimatization toward greater heat tolerance.

By correlation of weather data shown in Figs. 1-3 with mortality reports, it appears that several characteristics of changing environmental temperature must be considered with respect to their lethal effects on poultry. The first of these—perhaps the most obvious—are the absolute maximum temperature reached and the duration of the peak temperatures. These two factors relate to the limit of tolerance of an animal (irrespective of prior acclimatization) and to the length of exposure to the extreme temperature. As pointed out by Prosser (1951), length of exposure to high temperature is a critical determinant of lethal environmental temperature. Thermal stress imposed by several successive days of elevated maximum temperature with narrow diurnal fluctuation would, in effect, result in prolongation of exposure. This point has important bearing on the data presented in the accompanying figures. As mentioned earlier, weather data are reported from official weather stations which are shaded but not enclosed. It is justifiable to assume in every case that the daily maximum temperatures were higher in midwestern and eastern poultry houses where mortality occurred than at the nearby weather stations. Furthermore, the width of the diurnal temperature range was undoubtedly greatly reduced by the known lag in temperature decrease in an enclosed shelter. Thus, in all probability, both the maximum temperatures and duration of exposure were greater than the graphs would indicate.

Death due to high environmental temperature occurs when the capacity for heat loss is exceeded, with a concomitant rise in body temperature to the lethal range. It has been shown (Kendeigh, 1934, and others) that the margin of safety between normal body temperature and high lethal body temperature is very small in birds, as it is in other homeothermic animals (Prosser, 1951). The capacity for heat loss can, of course, be modified by physical means. It is noteworthy in this connection that some poultrymen in the California inci-

dent were able to reduce mortality to less than 1% by spraying the animals with water, a practice often followed under practical conditions. The magnitude of animal losses in the Oklahoma incident was, in fact, attributed to a drought preceding the heat wave which prevented spraying.

The capacity for heat loss and high lethal body temperature are both influenced to some extent by the degree of prior acclimatization. Hutchinson and Sykes (1953) have shown that heat tolerance of the fowl is improved after a series of short exposures to high temperature. After 24 successive daily exposures up to 4 hours in duration to a temperature of 99°F, the degree of hyperthermia resulting from continuous exposure to 104°F was approximately the same as that in unacclimated birds exposed to 99°F. Hillerman and Wilson (1955) have demonstrated that acclimatization with respect to internal temperature takes 3-5 days of continuous exposure (to either hot or cool environment), whereas respiratory rate changes require longer periods (8-10 days). Thus, in the study of Squibb (1958), adverse effects were not observed in fowls in areas where very high temperatures were recorded due to adequate opportunity for acclimatization and to the observed wide diurnal temperature ranges.

Other characteristics of changing temperatures which merit consideration are intimately related to the phenomenon of acclimatization. Among these are rate of change and the pattern of environmental temperatures immediately preceding the period of change. The importance of rate of change of daily maximum temperatures is illustrated by the Los Angeles-San Diego area data (Fig. 1). The very rapid increase which occurred in one day was coincident with reports of extensive mortality. Thus, it is evident that this rapid increase exceeded the limit of tolerance of birds previously acclimatized to a more moderate temperature. In light of the observations of Hillerman and Wilson (1955), it is likely that the 4-6 day period of relatively low maximum temperatures preceding the lethal period in the New Jersey data resulted in acclimatization of the animals to this environment. The subsequent heat wave was then more lethal than it might have been had prior acclimatization to the more favorable temperature not occurred. Probably equally important is the rate of change within a single 24-hour period, although accurate data on this

point are not available at present.

Since other weather variables, viz., wind velocity and relative humidity could exert effects on mortality during thermal stress, these data were scrutinized carefully. It was found that neither of these factors were correlated with mortality in the cases reported here. It should be pointed out, however, that both could become important at extremely high temperature and humidity levels. Kendeigh (1934) observed that survival time of adult passerine birds exposed to high temperatures was not influenced by humidity except when humidity was excessive. Lee *et al.* (1945) could demonstrate little effect of wind velocities ranging from 20-300 ft./min. at either moderate or high environmental temperatures.

On the basis of observations reported here, it is suggested that decisions of the commercial poultryman in application of preventive measures against heat death in his flock should be made after consideration of several factors. It is important that he be cognizant of the daily maximum and minimum temperature range and immediate area forecast. These determine the state of acclimatization of the bird. Little stress will be encountered with gentle seasonal changes; abrupt changes, however, will depress growth rate, egg size and production and may cause mortality.

SUMMARY

Three reports from different geographic areas of extensive mortality in poultry flocks resulting from thermal stress have been discussed together with reports of official U. S. Weather Bureau records of ambient temperature, wind and humidity data recorded during each instance. It is concluded that ambient temperature is a more important determinant of thermal stress than other weather parameters.

In each instance, heat death resulted from very sharp increases in daily maximum temperature following periods of more moderate environment. Several characteristics of the changing temperature pattern (absolute maximum, duration of peak temperature, rate of change, and pattern of diurnals immediately preceding period of change) are considered to be critical features of thermal stress occurring under natural conditions.

The significance of acclimatization in heat tolerance of poultry is discussed in connection with the temperature patterns related to mortality due to heat.

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FEEDING SYSTEMS FOR LEGHORN PULLETS

W. F. LAMOREUX* and HOBART R. HALLORAN**

As a result of some research and striking differences of opinion concerning proper systems for feeding egg strain pullets, poultrymen are asking the breeders how their chicks should be fed. These questions are sometimes directed toward the breeder, as though in hope that by some clairvoyance the breeder may evaluate diets formulated and prepared by feed companies, and prescribe some recipe for their improvement. This is not necessary or feasible for the breeders to do. Feed company nutritionists maintain up-to-date and well balanced formulas. The controversy continues, however, to raise unanswered questions concerning the hereditary requirements of the chicks, the nutritional quality of the diet, and feeding systems for maximum profit.

GENERAL OBJECTIVES

It is easy to agree that pullets should be fed a well formu-

* Director of Research, Kimber Farms Inc., Niles, California, U.S.A.
** Halloran Research Farm, Modesto, California, U.S.A.

lated diet designed to convert feed into eggs most efficiently.

In practice an existing system may need revising in view of new information regarding energy, proteins, vitamins, minerals and other types of recommendations of feed. Inevitably this has led to different types of recommendations for feeding replacements pullets. The poultryman may well wonder whether to place his pullets on full feed, or limit their feed by actual hand restriction, and whether high, medium or low energy rations will produce ready-to-lay pullets most economically. Fortunately the chicken has a lot of inherited adaptability that enables her to develop pretty much the same under surprisingly differing conditions; so the problem, though real, is much less serious than it would be otherwise.

DANGEROUS RECOMMENDATIONS

There are some incomplete recommendations on feed that should be considered carefully. One cannot safely recommend a certain level of protein without considering the source of the protein. Thirteen per cent protein in one formula may be the equivalent of 17% in another. The amount and nature of the fiber may influence the decision to use pellets or mash. Because less is eaten of high energy feeds the vitamin and mineral levels must be adjusted in proportion. And if hens lay larger eggs they will need more calcium than strains which lay a smiliar number of smaller eggs. (2)

It is becoming apparent also that ill health of chickens may increase some of their requirements (1). Unfortunately, most of our experimental work concerning nutrient requirements has been conducted with healthy chickens in a sheltered environment. We suspect that some of the estimates are too low for sick chickens.

ENERGY VALUES

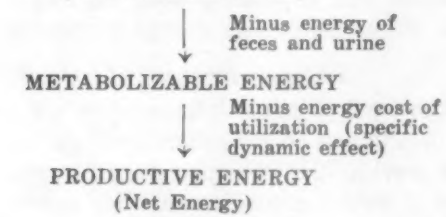
Feedstuffs differ so much in energy and cost that it has become customary to classify feeds as low, medium or high energy feeds. Sometimes the calculated caloric value is given. Even this may sometimes be confused by the use of two different terms, productive energy and metabolizable energy.

This difference between the two is illustrated in Figure 1. It seems apparent that productive energy is the measure we desire. The difficulties and inaccuracies involved in determining it are so great, however, that many investigators now

prefer to use the more readily obtainable and highly repeatable measure of metabolizable energy.

FIGURE 1

Summary of Definitions of Energy Values



These two measures differ so greatly that it is essential to know which is being used. The following approximate values for several ingredients illustrate the difference.

TABLE 1

Approximate energy values of some typical ingredients

	Calories per lb.	
	Metabolizable Energy	Productive Energy
Ingredient	Titus (7)	Fraps (5)
Corn Oil	3894(Veg. Oil)	2110(Corn Oil)
Corn	1535	1145
Milo	1528	1144
Wheat	1381	1024
Barley	1255	811
Wheat Bran	759	478
Alfalfa Meal (20% Protein)	619	314

In general discussions concerning low to high energy levels one is likely to find commercial feeds rated with values similar to those shown below. The productive energy value is approximately 70% of the metabolizable energy value.

Energy Level	Metabolizable Energy Values (Calories per lb.)	Productive Energy Values (Calories per lb.)
Low	860-1070	600-750
Medium	1070-1210	750-850
High	1210-1360	850-950
Ultra High	1360-up	950-up

The ranges in values are given because there are wide variations in what people call low, medium, and high energy. An example of a "practical" type of high energy ration is feed that has all of its grain from corn and/or milo. It will usually run about 900 calories of productive energy per lb. In order to achieve higher energy levels, it is necessary to add fat to the ration. Fat, depending upon the source, has about 2 to 2.5 times the metabolizable energy content of corn or milo.

GENERAL RECOMMENDATIONS

On the basis of present knowledge, we prefer that a pullet flock be started on a medium or high energy feed for the first few weeks. If a 24% protein prestarter is used for the first 2 or 3 weeks, a medium energy starter should be used until about the 8th week. At 8 weeks the pullets should be changed to a medium or low energy growing ration. The lower energy grower will tend to produce lighter pullets that will come into production a few days to 2 weeks later than birds fed a high energy diet.

Pullets receiving a low energy feed are lighter in weight and look "rougher." This may seem disadvantageous to the producer of started pullets, whose customers usually want smooth feathered, well fleshed pullets.

When pullets encounter high stress caused by disease, vaccination or extremes of temperature, some poultrymen and their feed suppliers believe that best success is reached by using high energy diets throughout the growing period. Such high levels of stress endanger the future performance of the birds, however, and signal the need for a change in procedures that will permit better health and development. The high energy diet, crumbles and pellets can then be held in reserve for emergencies.

Any consideration of the results obtained by different systems of feeding needs some standard for comparison. The data in Table 2 were recently published by the New York State College of Agriculture (5) to show average weights and feed consumption expected for pullets hatched in early spring and reared in confinement with high energy all mash rations, 1300-1400 calories metabolizable energy per pound. Effective restriction of energy intake would tend to give lighter weights. The use of lower energy diets would increase the amount of feed required to get a pound of gain.

TABLE 2

Growth and feed consumption data for Leghorn pullets

Age	Small Strains (4-4.5 lb. mature wt.) Average Weight	Feed consumption Previous 2 wks.	Feed consumption To Date
weeks	lb.	lb.	lb.
2	0.3	0.6	0.6
4	0.6	0.9	1.5
6	1.0	1.3	2.8
8	1.4	1.4	4.2
10	1.8	1.6	5.8
12	2.1	1.8	7.6
14	2.4	2.0	9.6
16	2.7	2.1	11.7
18	2.9	2.1	13.8
20	3.1	2.2	16.0
22	3.3	2.2	18.2

Age	Medium Strains (4.5-5 lb. mature wt.) Average Weight	Feed consumption Previous 2 wks.	Feed consumption To Date
weeks	lb.	lb.	lb.
2	0.3	0.6	0.6
4	0.7	1.0	1.6
6	1.1	1.5	3.0
8	1.5	1.6	4.6
10	1.9	1.7	6.3
12	2.2	1.9	8.2
14	2.5	2.1	10.3
16	2.8	2.2	12.5
18	3.1	2.2	14.7
20	3.3	2.4	17.1
22	3.6	2.5	19.6

Usually the use of a complete ration is advantageous. However, mash or pellets with grain can also be used. The grain should be limited if milo or corn is used. Barley can usually be fed free choice. Oats are not necessary but are excellent to use if they are priced right in comparison with the other grains. Because of their low energy and high fiber content many people recommend them as an aid for controlling cannibalism and for "automatic restriction" of the energy consumed by growing pullets.

Insoluble grit should always be fed, either mixed in the ration or supplied free choice.

Birds on floor litter should usually receive a coccidiostat which will result in considerable resistance to various types of coccidiosis and the poultryman should be prepared to start

special treatment promptly if unexpected exposure causes signs of an outbreak.

RESTRICTION OF FEED

Restriction of feed to perhaps 80% of normal intake for growing pullets has been widely practiced with specialized meat breeds of chickens. With egg strains the evidence seems less convincing. In some studies the restricted pullets have produced a few more eggs than controls while in others they have not. Whether these differences result from differences in diet or differences in management is not clear.

It is generally agreed that restricted feeding requires greater skill on the part of the poultryman. Perhaps because of this there is a growing tendency to apply an old practice of full feeding bulky low energy diets to provide a kind of "automatic restriction."

SUMMARY

In summary we recommend that a high or medium energy pullet starter be fed during the first few weeks. During the remainder of the growing period, birds that are developing in good health should be fed a medium or low energy diet. The prompt use of high energy diets should be planned however, for pullets that are sick, suffering seriously from vaccination reaction, or weakened by exposure. This will provide more readily available or more easily eaten, energy to assist in their recovery.

When production starts, and not later than about 22 weeks of age, we recommend a good laying ration, as nothing less can be expected to sustain really high egg production.

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A NEW RESEARCH CENTER IN FRANCE

L. P. Cochez, Director of the Domaine Expérimental Avicole du Magneraud, Saint-Pierre-d'Amilly par Mauzé (D.-S.), sent this photograph of their new Poultry Research Station.

The following data give details regarding the size of this research center:

Area—250 acres

Workers—65 people

Pedigree matings—120 pens
(1 sire and 15 dams)

Brooding capacity—24,000 chicks

Range shelters—24,000 chickens

Laying bird capacity—20,000 pullets

Hatching capacity—40,000 eggs per week

IV INTERNATIONAL CONGRESS ON ANIMAL REPRODUCTION

The Hague, Netherlands—June 5-9, 1961

The 4th International Congress on Animal Reproduction will be held in The Hague, Netherlands, on June 5-9, 1961. Whereas earlier congresses were devoted almost entirely to the subject of reproduction in mammals, this congress will include problems which arise in the reproduction of poultry.

The date of this 4th International Congress on Animal Reproduction has been chosen so that participants would be able to attend the 8th International Congress of Animal Husbandry which will be held in Hamburg, Germany, on June 13, 1961.

A folder containing further details on this 4th International Congress on Animal Reproduction will be available this spring. Those interested in receiving further information should write to:

IV International Congress on Animal Reproduction
14, Burgemeester de Monchyplein
The Hague, Netherlands

ERRATUM

The editor deeply regrets that the discussion of results and summary were inadvertently omitted from the article by S. Fox and Miss Rosalie S. Martin entitled "The Hatchability of Eggs from Hens Fed Rations Containing Different Protein Supplements"—World's Poultry Science Journal, Vol. 16, No. 1, pages 4 and 5. Of the four rations reported in the article, the ration containing 10% fishmeal led to a reduction in hatchability of fertile eggs of about 6%. At present the authors are undertaking work to see if there is a "safe" level at which to feed fishmeal in the ration, when depression in hatchability does not occur.

LONG DISTANCE TRANSPORTATION OF FOWL SEMEN BY AIR[1]

P. E. LAKE
A.R.C. Poultry Research Centre, Edinburgh, Scotland
H. SCHINDLER
Agricultural Research Station, Rehovot, Israel
F. H. WILCOX
Department of Poultry Husbandry, University of Maryland, College Park, Md., U.S.A.

SUMMARY.—Fowl semen was flown across the Atlantic from the University of Maryland, U.S.A., to Israel and Scotland. An account is given of the method used to dilute and transport the semen, and the fertility results obtained during the first week after insemination.

Fowl semen has proved particularly difficult to store *in vitro* and from research in progress it seems possible that part of the failure is due to a lack of fundamental knowledge of the chemical and physical nature of the semen. Consequently when spermatozoa have been held *in vitro* they have been placed in unfavourable fluid environments with regard to composition, osmotic pressure, *p*H and buffering capacity. Many synthetic media and biological fluids have been used empirically either separately or as a mixture for fowl semen diluents, *e.g.* Tyrode, Ringer, Ringer-Locke, glycine, yolk-phosphate, yolk-citrate solutions, albumen and milk. All of these have either a different osmotic pressure to fowl seminal plasma or a poor buffering capacity; with the exception of a single report of fair success using milk or albumen with citrate-glucose- saline and milk with Ringer as diluents and storing semen for 24 hours (Polge, 1955), none has proved consistently satisfactory for storage purposes (Schindler, Weinstein, Moses & Gabriel, 1955; Takeda, 1954).

Wilcox and Shaffner (1957) showed that simple phosphate buffers, with freezing point depression measurements in the range –0.607° to –0.639° C., to a certain extent preserved the fertilising capacity of fowl spermatozoa *in vitro;* subsequently using one of the buffer solutions with added antibiotics, they obtained promising fertility results after storing semen for 24 hours at 10° C. (Wilcox & Shaffner, 1958). As an interesting experiment it was decided to use

[1]Reproduced from the Veterinary Record, January 17th, 1959. Vol. 71, No. 3, pp. 52-4.

the latter method in an attempt to transport semen long distances by air from Maryland, U.S.A. to Israel and Scotland, and the present paper reports the fertility results obtained after such a venture.

METHOD AND MATERIAL

Semen was collected by the customary method from 8 Flightless (90 per cent. New Hampshire and 10 per cent. White Leghorn blood) and 8 Broiler (Barred Columbian) strain males kept at the University of Maryland, U.S.A. It was immediately diluted ten-fold with a buffer containing antibiotics [Na_2HPO_4, (16.34 g.), $Na\ H_2PO_4$, H_2O (5.16 g.), oxytetracyline* (100 mg.) and dihydrostreptomycin (1 g.) per litre] and placed in plastic vials. Then a can containing ice was wrapped in cotton wool and placed in a paper bag. The vials were placed around the outside of the bag, and the whole put in an insulated container. This procedure was devised at Maryland to maintain a temperature of 10° C. Samples of semen were taken to the nearest airport and flown to Scotland and Israel. Upon arrival at the respective laboratories in the two countries the semen was centrifuged (1200 RCF) for 10 minutes and the supernatant poured off. The spermatozoa were resuspended in enough phosphate buffer, containing no antibiotics but 2.5 mg. per ml. of fructose, to bring them to their original semen volume. Hens were inseminated deeply into the vagina with 0.1 ml. semen by the customary procedure. As the semen samples arrived at their destinations in the early morning some hens had eggs in their uteri and note was taken of these cases in the analysis of fertility results.

The following types of semen from the same males were inseminated in two control tests at Maryland: (1) 0.1 ml. undiluted semen and (2) 0.1 ml. semen diluted and stored approximately for the same time taken for the long distance transport.

RESULTS

The fertility results are summarised in Table I. The total elapsed time from collection of semen to insemination was 38 hours to Israel and 37 hours to Scotland. The temperature of the semen upon arrival was 11° C. and 10.8° C. in the respective countries.

* Terramycin.

TABLE 1

Fertility results obtained with transported semen

Treatment of semen	Number of hens inseminated	Number of hens producing one or more fertile eggs	Number of eggs set	Per cent. fertility (eggs laid 1st week)	Per cent. hatchability
Transport to Israel					
1. Fresh, undiluted semen used at Maryland	10	9	47	81	94
2. Stored 35 hours at 10° C. and treated as transported semen at Maryland					
(a) Hen without egg in uterus	10	4	41	17	67
(b) Hen with egg in uterus	10	4	40	18	50
3. Transported semen	27	18	125	38*	not recorded
Transport to Scotland					
1. Fresh, undiluted semen used in Maryland	10	10	46	94	95
2. Stored 43 hours at 10° C. and treated as transported semen at Maryland					
(a) Hen without egg in uterus	10	3	45	16	71
(b) Hen with egg in uterus	9	2	38	8	100
3. Transported semen	20	13	100	36†	81

* 49 per cent. from 8 hens with hard-shelled egg in uterus; 33 per cent. from 19 hens without hard-shelled egg in uterus.

† 25 per cent. from 8 hens with hard-shelled egg in uterus; 43 per cent. from 12 hens without hard-shelled egg in uterus.

DISCUSSION

The fertility results obtained with semen which had been pacakaged and sent on journeys lasting more than 30 hours were encouraging, and give added stimulus for more basic work on the physiology of chicken semen, and consequently better methods of handling the material. Lake (unpublished observations), using Ramsay's (1949) micro-method, estimated the freezing point depression of fowl seminal plasma to be between –0.59° and –0.6° C. and Schindler *et al.* (1955) gave a value of –0.64° C. for whole semen. Both these values are higher than that for bull seminal plasma, –0.53° C. (Rothschild & Barnes, 1954), which could indicate that the plasma of the fowl is different in composition from that of the bull, and in this respect should warrant special attention when the dilution and storage of fowl semen is under consideration. Recently, very promising fertility results were obtained using semen which had been stored for 24 hours (Lake, 1958); the composition of the diluent was based on a partial chemical analysis of protein- and lipid-free seminal plasma. The results of the present test were obtained by using a method of diluting and storing semen derived from observations on the best *p*H, buffering capacity and osmotic pressure required of a phosphate buffer solution for preserving the fertilising capacity of fowl spermatozoa (Wilcox & Shaffner, 1957, 1958).

The present work and its extension has many implications of practical importance with regard to the transport of poultry. There is probably less chance of introducing disease from one country to another, as compared to the shipment of hatching eggs, chicks and adult birds. The semen shipped was diluted with a solution containing the antibiotics, oxytetracycline and dihydrostreptomycin. The cost is less. A quart of diluted semen could be shipped fairly inexpensively and would be enough to inseminate 1,000 hens. At 37 per cent. fertility, 2,000 chicks could be hatched from a single shipment. This procedure offers a faster method of introducing high production stock where it is desired to eventually cross it to native chickens. By this method the latter can be inseminated with semen from high production stock, which saves a year in breeding programmes for improving native stock.

The future prospects for world-wide transport of chicken semen appears bright provided the semen could be allowed through customs barriers and satisfy animal health controls.

Improved fertility should be obtained with either better cross-country airway connexions or faster planes to shorten the time in transit, and with better methods of handling semen *in vitro* which should arise from extended research on the nature of fowl semen, the behaviour of the spermatozoa, and indeed the whole subject of reproduction of the bird.

Acknowledgments.—The shipment of semen to Israel was made possible by the production of a certificate from a federal veterinarian in the U.S.A., stating that the stock at Maryland was free of disease communicable by semen. The help of Drs. S. Bornstein, E. Moses and I. Gabriel is acknowledged.

The part of the experiment in Scotland was made possible through the granting of a licence solely for scientific purposes by the British Ministry of Agriculture, and the Department of Agriculture for Scotland. The trial was carried out at an official laboratory under strict precautionary safeguards which included the destruction not only of all progeny chicks but of all hens involved. The authors are very grateful for the above mentioned permission, and to Dr. J. E. Wilson, Director of the Ministry of Agriculture's Veterinary Research Laboratories, Lasswade, Scotland, for arranging facilities to house and isolate hens for insemination purposes and for collecting fertility and hatchability records.

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EGG PRODUCTION IN CANADA

F. G. PROUDFOOT

Research Officer (Poultry),
Experimental Farm, Canada Department of Agriculture,
Kentville, Nova Scotia, Canada

Egg production is still the major source of income for Canadian poultry producers. Despite the great emphasis placed on commercial broiler and turkey production in recent

years the sale of eggs represented about 46 per cent of the total income from poultry products in 1957. Moreover, a large portion of poultry meat sales are in the form of fowl which is really a part of the egg production enterprise. Therefore, it may be stated that over one-half of the poultry farm cash income is received by farmers for the sale of eggs and fowl from egg production enterprise.

During the past decade the volume of egg production in Canada has expanded at a slightly faster rate than the human population. This extra volume of production has been largely taken care of by an increase in the per capita consumption of eggs which in 1957 amounted to 25.4 dozens as compared with 22.1 dozens in 1952 and 20.6 dozens in 1947. Canada's international trade in eggs is of relatively low volume, sporadic, but nevertheless important in the maintenance of a supply balance on the domestic market which is necessitated by the cyclic mode of the industry's expansion.

REGIONAL DEVELOPMENT

Available data indicate that Prince Edward Island, Ontario, Manitoba, Saskatchewan and Alberta are the provinces which produce more eggs than normally required for their own consumption; British Columbia and Nova Scotia are practically self-sufficient, but a movement of eggs is required into Quebec, New Brunswick and Newfoundland.

In Novia Scotia, poultry and egg sales provided 27 per cent of the total cash farm income in 1957, representing the largest portion of farm cash income of all Canadian provinces. In British Columbia and Ontario, the sale of poultry products represented about 24 and 18 per cent, respectively, of the cash farm income.

There are a number of physical and economic factors which influence the development of an egg production industry in a particular region. One of the more important influences is the general philosophy and adaptability of the people in a particular area. This phenomenon has been exemplified in the dynamic development of the poultry industry in many areas of the country. It was in areas where there existed an appreciation of the economic advantage of large flock size and the application of other business principles that the industry expanded on a commercialized basis.

Despite the pronounced trend toward automation in egg

production, the available labour supply has undoubtedly exerted some influence upon the development of the enterprise in particular regions. It is apparent (Table 1) that farm labor costs decrease from west to east in Canada. Since labour represents a large part of the cost of production this would favour poultry producers in Eastern Canada.

The Freight Assistance Policy on feed grains, coming into effect in 1941, has had an important effect upon the dis-

TABLE 1

The hourly wage rate index for farm labour, 1957

Region	Index
British Columbia	100
Saskatchewan	91
Alberta	86
Manitoba	79
Ontario	79
Quebec	67
Maritime Provinces	59

position of egg production. From a national viewpoint, production has been decentralized, moving closer to consumer centres and thus reducing marketing time and cost. Decentralization in this manner has also made available eggs of higher quality than would otherwise be possible. It should be recognized, however, that although lacking the advantage of proximity to consumers, the wheat-producing provinces are an exception, since they produce more eggs than they consume. This is probably because the poultry enterprise provides some western grain growers with an indirect method of selling grain. Despite substantial freight assistance (Table 2), the over-all feed costs to poultry producers on the Eastern

TABLE 2

Freight assistance payments on grain and feed shipments to Eastern Canada and British Columbia, October 1941 to October 31, 1956

Province	Total amount of money paid	Average net cost per ton
	(1000 dollars)	(dollars)
Ontario	80,154	4.92
Quebec	101,243	6.52
New Brunswick	15,395	9.15
Nova Scotia	21,478	10.13
Prince Edward Island	5,500	10.02
Newfoundland	2,569	20.76
British Columbia	25,128	7.02
Total	251,466	6.31

seaboard are higher than to poultry producers in other parts of Canada. This feed cost differential still exerts a marked influence on the production of eggs in the Atlantic Provinces and tends to more than offset lower labour costs.

Extremes in temperature may have some detrimental effect upon the economic performance of fowl. It is obvious (Table 3) that southern parts of Canada's coastal and Great

TABLE 3

Averages of annual extreme minimum and maximum temperatures at selected locations in Canada

Locations	Minimum °F.	Maximum °F.	Number of years observed
Vancouver, British Columbia	13	86	38
Calgary, Alberta	—33	91	53
Regina, Saskatchewan	—42	96	50
Winnipeg, Manitoba	—38	94	65
Toronto, Ontario	—11	93	105
Montreal, Quebec	—18	90	69
Fredericton, New Brunswick	—25	91	67
Halifax, Nova Scotia	—8	89	77
Charlottetown, Prince Edward Island	—13	85	63

Lakes regions have more moderate temperatures, a factor which favours the development of the poultry industry in these areas.

Statistics indicate that seasonal variation in production is greatest in regions where temperature extremes are greatest. This phenomenon, however, may not be due to temperature effects but to the influences of other competitive farm enterprises in these regions.

The growth of an egg-production enterprise is also dependent upon industrial activity, availability of competitive foods, transportation facilities, marketing facilities, and eating habits of the consumers in the area. It would appear that current economic pressures tend toward a decentralization pattern of production, with the industry developing in close proximity to the consumer.

COMMERCIAL VS. FARM FLOCK

During the past 20 years a definite trend has developed toward poultry flocks of larger size. Despite this trend, in 1956 an estimated 40 per cent of the country's egg production was produced by flocks with a size of less than 300 birds. In 1951 about 23 per cent of the eggs were produced by flocks with a size of 525 birds or over, whereas in 1956 approximate-

ly 38 per cent was produced by flocks in this size category.

Under the economic pressure of narrowed profit margins per bird, the trend toward larger flocks is expected to continue with a large number of small farm flocks being replaced by a reduced number of bigger flocks and a greater degree of specialization in the industry. This does not mean that the farm flock will cease to exist, but rather that its size will expand. Current indications are that many of the economies of the large commercial operation can be attained, and some of the hazards reduced, with a farm flock consisting of one to two thousand layers. This larger farm flock should be sufficiently important in the over-all farm business to require the detailed attention of the farmer and to result in the wider use of efficient production methods.

The effects of reduced profit margins have been experienced by the specialized egg producers, as well as the farmer with the small flock. The specialized producers have met the challenge and will play an increasingly important role in Canada's egg production. The general financial structure of these commercial poultry farms will probably tend to take on that of a corporation, with profit returns in the form of interest on investment, or become an integrated part of a larger organization.

VERTICAL INTEGRATION

In recent years larger capital funds have been required by poultry producers. This has been caused by rising production costs, the increasingly competitive nature of the industry, and a resultant increase in the scale of operations. The requirement for capital funds by producers, coupled with the desire for a continuous supply of a uniform product by marketing agencies, is partly responsible for the trend toward vertical integration or contract farming. In contract farming the producer enters into a contract of partnership with an outside organization, usually a feed supplier or processor, who provides necessary finances and takes some of the risks but who also exercises some control over the livestock and provides technical advice and service. Such arrangements are common among broiler growers and appear to be developing among egg producers.

Although the principal reason for the development of contract farming was a need for capital funds, another reason was the need for professional and technical direction to man-

agement. This has become of increasing importance since the production profit margin per unit has narrowed. The producer who wishes to preserve his independence must not only provide the necessary capital but must have access to the most up-to-date technical knowledge in order to remain competitive. This trend will increase the demand for professional personnel in the agricultural industry. The greatest need will be in the field of service to farm operators. The farm operator, in turn, will require the ability of a skilled manager.

PRODUCTION MANAGEMENT TECHNIQUES

One of the most fascinating facets of the poultry enterprise is the manner in which domestic fowl respond to different environmental influences. The reaction of fowl to environmental stimuli, not yet fully understood, is receiving increasing attention from researchers and all those directly concerned with the general performance of fowl.

The concept of "stress" effects, in their different forms and combinations, is coming into focus. For example, an appreciation of the fowl's "social system" or "pecking order" is of importance and should be taken into consideration when arranging waterers, feeders, roosts and nests within the brooding, rearing and laying pens.

In recent years an increasing number of pullets have been reared in confinement rather than on range. Research indicates that rearing method (range vs. confinement) makes little difference in the performance of egg production fowl although range-reared birds lay larger eggs and have poorer feed efficiency in the laying house than birds reared in confinement.

Evidence has accumulated that restricting nutrient intake during the growing period improves over-all performance during the laying period. Much of the research has been done on Leghorn type stock. It is probable, however, that heavy type layers, in fact all livestock, may respond favourably to restricted feeding—depending, of course, on the ultimate use to be made of the stock.

Preliminary research on controlled lighting throughout the life of the laying bird indicates that substantial gains in egg production are possible without apparent detrimental effects on other traits. This light schedule involves the restriction of light to 6 hours, or less, per day during certain phases

of the birds' life and increasing the light day to almost 24 hours at other times. Much is yet to be learned regarding birds' responses to light stimulation.

The effect of pen temperature control on birds during the growing and laying periods has not been fully explored. Temperatures of 50-60°F. during the laying period appear to be optimum, while extreme temperatures are detrimental to economic performance.

In the face of narrowing economic production margins producers are looking for new ways to cut costs. Since labour represents a large portion of the total cost of production, considerable attention has been directed toward means whereby man-hours per thousand layers may be minimized. The construction of larger laying pens with some insulation has enabled poultry producers to reduce frost hazard and install automatic waterers, thereby improving labour efficiency. A more recent development was the introduction of the mechanical feeder which in some instances effected a reduction in production costs. The use of bulk feed has served to reduce man-hours, particularly where mechanical feeders are being used. The use of the all-mash feeding system is becoming more common because it is adaptable to the bulk handling of feed and mechanical feeding.

Poultry producers have endeavoured to combat the rising cost of building construction by reducing the floor area per bird in the laying pens. This greater concentration of birds introduced new problems, mainly in the realm of ventilation. Many producers have had to install forced-air ventilation systems in order to adequately control ventilation, temperature and humidity. A small number of poultry farmers have attempted to solve some of their floor concentration problems by using slatted or wire-covered pen floors; others are using community or individual laying cages. Cages and slatted or wire floors have not been used long enough to determine whether they will be important in egg production operations of the future.

The Leghorn type commercial bird is currently being evaluated by egg producers in this country. Until a few years ago, relatively high fowl prices were believed to favour the heavier type birds. Today, with the development of broiler meat production resulting in much lower fowl prices, it is probable that more producers will turn to the Leghorn type

layer with its longer productive life and improved feed conversion.

MARKETING

Since 1950 the marketing margin, as a per cent of the consumer's dollar spent for eggs, has been increasing. In 1950 the Canadian farmer received 78 per cent of the retail price of eggs, but by 1957 this was reduced to 69 per cent. During the same period the prices paid to producers showed a downward trend, with prices paid in 1957 being the lowest recorded for the preceding 10 years. This development seems to be due to the inelastic nature of marketing margins in the face of declining prices, rather than a real increase in cost of marketing services, although the latter have undoubtedly played a small part.

The per capita consumption of eggs in Canada is lower than that experienced in the United States, which would indicate that an increase in domestic disappearance of eggs in Canada is within the realm of possibility.

Although consumers are demanding more marketing service, there is hope that some marketing costs can be reduced. This economy may be enhanced by a reduction in time-lapse between production and consumption and by the introduction of a greater degree of automation in the marketing process, particularly in the process of egg candling, which may be done electronically in the future.

Canada has an enviable reputation for the production and marketing of eggs of good quality. Despite this reputation we can expect an improvement in egg quality as the trend to large flocks continues and as producers, marketing agencies and consumers become fully aware of proper handling methods. The future may also see the development of new processes of quality preservation, involving such things as shell sealers, which will supplement refrigeration and ensure a better product for the consumer.

In view of the prevailing reduced production profit margins, it should follow that those engaged in marketing eggs will exercise some caution in increasing consumer service and at the same time endeavour to develop greater efficiency. Thereby they will continue to make available to the consumers of the nation a highly nutritious food item at competitive prices.

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CANADA'S BROILER PRODUCTION

ROLLAND POIRIER
Technical Adviser, Pioneer-Cafeteria Feeds Ltd., Montreal, Que., Canada

Many gradual changes have occurred in the eating habits of our country in the course of its short history. In the last 50 years, there has been an increase in fruit and meat consumption, together with a definite trend towards lean meat. We have changed our hogs from a fat to a bacon type and lean beef is the most important item in our diet.

In the last decade, another important change has occurred and this one has taken on the impetus and the speed of a revolution. Poultry meat, which for many years was restricted to festive occasions, has become a current item on the marketing list of Mrs. Average Housewife. Fowl, large chicken and turkey have played their respective parts in this change, but the phenomenal growth of poultry meat consumption is due mainly to a small and young bird which has acquired the name "broiler", even though it is prepared in many other ways.

Important changes in eating habits usually have sound economic causes. It may be a new crop which is well adapted to soil or climate; it may be a product which lends itself to easy transportation and safe conservation. A short analysis in the case of the broiler brings out the following simple facts. A chicken, like most other animals, takes less feed to make a pound of gain when it is still young. However, the chick cost per pound of meat sold is lower when the bird is older. It is then a simple problem to find out when the economy of energy transformation indicates that the chicken should be sold. Once we have found the most economical age, then another important factor of success must be considered: What is the flavour of the bird at that age? In the case of the broiler, the tenderness, the aspect of the covering fat, and the flavour, have all worked towards the success of the product. Broiler meat is gaining in popularity because it is produced on the basis of the sound economical factors mentioned. Hog producers one day may regain a part of the ground they have lost, if they can solve a similar equation of energy transformation.

The calculations of experiments and the practice of many years have shown that a bird between 3 and 4 pounds live-

weight gives the best return. A tremendous amount of work has been applied in different sectors of this industry in order to improve the production of such a bird and fortunately it fits in well with the tastes of Canadian consumers.

HOW LARGE IS THE BROILER INDUSTRY?

As to the number of persons connected with this product, we can say that it is rather low, even if we include with the feeders the persons working in processing plants, in feed stores, and in allied businesses such as equipment, feeds, medication, etc. The industry is quite large if we consider the volume of production and the capitalization.

This industry is too young to have evolved a sound statistical method of registering its history but recent attempts at getting reliable figures on production have met with some success and we now can estimate more accurately what is truly going on. (Most of the figures given in this article must take these limitations into consideration).

We can estimate the total Canadian production for 1958 at a little over 60,000,000 birds. This means a live weight of approximately 200,000,000 pounds, which corresponds to a revenue of approximately $45,000,000 for the feeders. The consumers have paid approximately $70,000,000 for broilers and, therefore, $25,000,000 has gone to processors and retail stores.

The capitalization in farm buildings and equipment alone must be in the neighborhood of $50,000,000. We must add to this the capitalization of processors, retail stores, and allied businesses which is almost impossible to approximate; but we may be sure that it runs into many more millions of dollars.

For an industry which is approximately 10 years old, this development is phenomenal, and to think that all this happened in the most conservative (etymological sense) class of society, in agriculture! No wonder the broiler industry is always given as the example of "things to come".

HISTORY OF CANADIAN BROILER PRODUCTION

To be fair to our southern neighbors, we must concede that many of the basic ideas in broiler production have been imported from the United States. We are still behind the Americans in per capita consumption of this kind of meat; but the gap between the two figures is diminishing steadily. Table 1 will illustrate this fact by giving U.S. production

figures since 1934 and an estimate of Canada's broiler production since 1952.

TABLE 1

Production of Broilers in Canada and the United States

Year	Canada	U. S. A.
1934		34,030,000 birds
1940		142,762,000 birds
1946		292,527,000 birds
1952	7,000,000 birds	860,891,000 birds
1953	13,000,000 birds	946,533,000 birds
1954	16,000,000 birds	1,047,798,000 birds
1955	25,000,000 birds	1,078,264,000 birds
1956	33,000,000 birds	1,345,000,000 birds
1957	41,000,000 birds	1,452,000,000 birds
1958	60,000,000 birds	——

Now we shall try to list chronologically some of the more important developments in this industry in Canada:

1935 Chicken barbecues were started in Montreal; a few of these restaurants have done uninterrupted business since then. The barbecue specialty has been a big influence in introducing broilers to the Canadian people.

1945 Broiler production came of age and papers on the subject began to appear in the *"Canadian Poultry Review"*. Such articles stated that, using males almost exclusively, one could get a 3-pound bird in 12 weeks with a feed conversion of 3.5 to 4.0 pounds of feed per pound of gain.

1948 One Ontario broiler processing plant proudly announced that it could process 6,000 broilers a week. There was a "super" unit of production which contained 30,000 birds. We were starting to use both sexes in some flocks; in others, we sold the males as broilers around 12 weeks and kept the females as layers. In this same year, broilers began to be an important item in chain-stores.

1949 Large barbecue meals were served at poultry gatherings in Eastern Canada.

1950-51 We saw on the Canadian market, for the first time in large quantities, the specialized strains and crosses of meat birds which were produced commercially in the United States. Penicillin was used as a growth factor and this marked the beginning of the era of antibiotics and other feed additives.

A few large broiler houses had automatic feeders.

1952 For the first, but not for the last time, the following title appeared in the *"Poultry Review": "What's wrong with the broiler business?"* Prices had gone down to an all-time low

at 26 cents a pound live weight, after two years of returns at over 30 cents a pound. In the same year, feed with a coccidiostat was put on the market; it reduced the risk of coccidiosis but did not eliminate it entirely.

1953 Many producers started to vaccinate against Newcastle disease.

1954 Wide spectrum antibiotics like aureomycin and terramycin were added to feeds. In the spring of this year, another important crisis was created by low prices. Bulk feed installations were started, reducing to a minimum feed handling and eliminating costly containers.

1955 NF-180 was added to antibiotics for disease protection and growth stimulation. In the same year, prices fluctuated from 22 to 30 cents a pound, live weight, showing wide variations in offer and demand.

1956 In 1956, vaccination against bronchitis became a more general practice. In the fall of that year, another crisis in prices brought broilers to an all-time low of 17 cents a pound, live weight.

1957 Animal fat was added to feeds and it contributed to improved feed conversion.

1958 In the fall of 1958, production again ran ahead of consumption and prices dropped as low as 15 cents a pound, live weight, during December. Now people are asking again: *"What is wrong with the broiler business?"* Let us have a look at it.

PRODUCTION AND DISTRIBUTION TODAY

Through the process of trial-and-error, and through the knowledge supplied by experimentation, the production of broilers has been very much standardized and the following remarks may well apply to over 80 per cent of today's production in Canada.

Chicks

The birds are supplied by specialized hatcheries on a schedule specifying the week of delivery for the next 12 months. These hatcheries have a franchise for the production of trade-marked American birds. The breeding of these birds is done almost entirely by large organizations in the United States. Only one or two Canadian organizations are now selling a bird which is improved and controlled entirely by themselves. These birds used as such or in crosses can produce a broiler of nearly 4 pounds in 10 weeks. Such a broiler has an

excellent conformation and it can take the necessary finish at an early age.

Houses and Equipment

The broiler house in Canada is very often a converted barn and, therefore, has three and even four storeys. A few of the newly built houses are of the long and wide one-floor model, but the long cold winter seems to give an advantage to multifloor buildings.

One feature which is of primary importance is adequate insulation. The problem of ventilation varies with each building, but it is a deciding factor in the success or failure of an operation. There is a tendency to eliminate windows and replace them with regulated air intakes. We are still waiting for the ideal ventilation system, but we have the choice between many commercial systems containing automatic fans, baffle-boards, thermostats, etc. By putting one bird per square foot, we create two problems which must be solved by ventilation. We need oxygen for respiration and we must eliminate the carbondioxide of expiration. Furthermore, we must eliminate the humidity and ammonia generated by expiration and the excreta.

Birds are kept in semi-darkness; just enough light for them to see the feeds and water, but not enough to encourage any other activity.

Broilers are raised on litter and the usual procedure is to change litter with each new lot.

Automatic feeders in conjunction with bulk bins can reduce feed handling to a bare minimum, but many excellent producers prefer to have tubular feeders which they fill by hand. This chore makes it necessary to visit all the birds at regular intervals so that a producer can eliminate any cause of stress as soon as it occurs.

Equipment must be calculated so that a bird does not have to move more than 10 feet at any time to reach water or feed.

Diseases

Diseases are actually the limiting factor which prevents any more spectacular advances in the broiler industry. You may improve the genetics, the feeds, the equipment and ventilation; but if you have sick birds these improvements will not show.

Two serious diseases now can be prevented by vaccina-

tion—Newcastle disease and bronchitis. However, this procedure costs money, and many times the stress created by vaccination will be enough to trigger a crisis of C.R.D. This is an abbreviation for the most costly disease of broilers, chronic respiratory disease, which can occasionally produce a high mortality and which always increases critically the number of pounds of feed needed to produce a pound of meat. This disease can also have influence on the quality of the birds and can disqualify many of them at killing time.

Antibiotics have been used and continue to be used to minimize the secondary effects of many diseases, including C.R.D. They are given at varying levels in the feeds or in the water. The phenomenon of adaptation of organisms to a drug, whether it is through a genetic process of natural selection or through any other process, has been proven without doubt in the case of broilers. Penicillin has worked for a while; then aureomycin and terramycin have now taken over the protection of broilers with some success. In certain environments, right now, these two wide-spectrum antibiotics are declining rapidly in efficiency and we must find other antibiotics to replace them. Furazolidone, better known as "NF-180", has started its role of protection. We do not know yet how long it will be resistant to adaptation, but we may venture the prediction that it will have the same destiny as the antibiotics.

It seems that as we improve our position in animal production by creating an environment which is more and more artificial, we must pay a tariff to nature in the form of a struggle with disease which becomes more and more difficult.

Feeds

Improvement of feeds has helped to make the broiler industry possible. Today we can produce in 9 weeks a broiler of an average weight of 3.5 prounds with feed conversion of 2.6 in many commercial operations. On an experimental basis, we can do much better.

The energy part of our feeds is supplied by the three grains—corn, wheat and barley. For several years, we have been able to raise the calories of broiler feeds by using animal fat. So far the level of fat which seems to be economical to use varies up to 5 per cent. Using more will improve the efficiency of feeds, but the extra expense at today's price, and the difficulties of handling the product, seem to limit

its use to that level for the time being. The protein part of the feeds is supplied by three sources—vegetable, animal and fish. Soybean oil meal, meat meal, whey powder and fish meal are products used most often for proteins.

The following vitamins are taken into consideration in a formula for broilers: vitamin A; vitamin D3; vitamin K; thiamine (vitamin B-1); riboflavin (vitamin B-2); pantothenic acid; niacin; Pyridoxine (vitamin B-6); biotin; folic acid; choline; vitamin B-12. Many of these are supplied entirely by the chosen ingredients, but the following must be added as such: vitamin A, vitamin D, riboflavin, choline and vitamin B-12.

Minerals are also taken into consideration, and there are specific ingredients such as iodized salt, dicalcium phosphate, limestone and manganese sulphate.

Finally, we add to a formula for broilers other ingredients which have proven beneficial, either as a growth stimulant or as protection against disease. Here are a few of these products: antibiotics or nitrofurans; coccidiostats; corn distillers' or corn fermentation solubles; arsanilic acid; methionine; dehydrated alfalfa or cereal grass.

Before me is a registration for a broiler feed which contains 30 different items. It is a wonder that such a small bird, which in nature can survive on so little, can cause us so much work to feed it!

This highly complicated feed is likely to be put through a special process in order to serve it in the form of crumbles or pellets. This process uses steam and compression and cooks the ingredients partially, thus increasing their digestibility.

PROCESSING AND MARKETING

Processing and Marketing

Very little of the broiler volume goes through the freezing process and therefore it must be considered as a perishable food. For this reason the minimum time must elapse between the collection of the live birds on the farm and their consumption by the customer.

Processors pick up the birds at the farm according to a prearranged time-table, usually at night, and carry them immediately by trucks to the plant. There, they are passed through an assembly-line which kills them and processes them almost entirely by machine with the help of very few persons. Such assembly-lines can now handle 2000 to 3000

birds an hour in some Canadian plants. The eviscerated birds are packed in chipped ice and sent within 24 hours to the retail store or restaurant.

The bulk of the broiler production is now sold through retail grocery stores with chain-stores handling most of the birds. Broilers are still the best "leaders" to bring customers to a particular store. Broilers at a low price have often done a marvellous job in marketing this product in times of overproduction. However, such sales have been repeated too often, and now broilers and low prices are linked together in the consumer's mind. Consequently, it is more difficult to establish a continuous market at a price which will leave a resaonable profit to the producer, the processor and the retail store. Such a price would still place this meat in a class of its own as being the most economical for the consumer. Unless some quick reasoning and collaboration is done, all through this new industry, we shall be in the sad position of having a product which the consumer wants but which nobody can afford any more to supply him.

Another excellent source of broiler consumption is the same one which at the beginning, in the thirties, helped to introduce this new food to the public, the barbecue restaurants. Montreal is still the most important centre of such restaurants, but we see more and more of them in the important consumption centres such as Toronto, Hamilton, Calgary, Vancouver, Halifax, etc.

Finance-Contracts-Integration

It seems that the broiler industry has been and continues to be some sort of laboratory where economical experiences are tried before being applied to the rest of agriculture.

In our capitalistic system, loan institutions have developed in order to supply building and working capital for almost any industrial production. Such institutions have refused to extend their activities in some fields of agricultural production, either because they did not understand the nature of the risk or because their regulations were not flexible enough.

It was not long before the broiler production took on such proportions as to necessitate financing to cover new buildings and also working expenses, such as the buying of chicks, the supply of feeds and other necessities. The broiler cycle is a short one, 3 months at the most, and feed companies, be-

cause they are the most important suppliers, have agreed to replace the banks. At first contracts were written to cover the amounts due for feeds but, because of competition, these contracts have been extended to cover almost anything. When the feed companies realized the extent of their risks, they started to take all necessary steps to guarantee their funds and this has led to what we now call "contract-farming".

The essence of contract-farming is that a farmer supplies the buildings, the equipment, his time and work for the production of broilers. The feed company, or the broiler processor, supplies the birds, the feed, the medicine and the market for the finished birds. The farmer is paid a fixed fee, and he relinquishes ownership of birds and decisions to the company. The fee that he gets is usually based on efficiency of production; it may or may not be connected with the market price of broilers. The farmer may avoid the risk of a loss but, in order to get this privilege, he also avoids the possibility of profits increasing with the market price.

The next step in broiler production has been the combination of production, processing and marketing within the same organization. We have in Canada some firms which have a hatchery for chicks, a mill to produce the feeds, some broiler houses to raise the birds, and a processing plant which prepares and markets the broilers. These complete broiler organizations are very few. Usually we have a combination of only a few of the operations. We may have a processing plant which owns the birds, buys or supplies the feeds, but does not own the buildings where the birds are raised. We have others where the feed supplier owns the birds which are raised on a fee basis by farmers and then sold under contract to a processor.

A question is often asked: *"Which is the best financing formula for the production of broilers?"*. Before answering we must query: *"Best for whom?"*.

Best for the consumer? Complete integration, when well done, may lead to the most economical way of producing a pound of meat, but such a method leads also to the concentration of this production in the hands of a few persons who may afterward dictate their own prices. Consumers may lose in the long run.

Best for the farmer? The integration should go just far enough so that the farmer can get the necessary working capi-

tal, so he can have a sure supply of quality chicks, so he can get the necessary technical help, and so he can be sure of an outlet at market prices for his finished product. For anything beyond this, he usually pays more than it is worth. If he wants to eliminate the risk of a loss, he must at the same time forsake the possibility of an interesting profit. A broiler grower must have enough capital at stake so that he can choose for himself a formula of integration which suits his purpose. Such a formula should not be imposed upon him because of his weak position or his lack of business knowledge. The kind of limited integration just described is possible because it exists actually and it should be encouraged by all sections of the broiler industry. Integration which respects the independence of the farmer, although it recognizes his interdependence with the other sections of the broiler industry, is the only kind which is socially sound and, therefore, should be the only kind pursued.

PREDICTIONS FOR THE INDUSTRY

An article such as this should end on an optimistic note, and there is no better way of creating it than by looking through the crystal-ball to the future.

Genetics promise a bird which will reach 3 pounds in 7 weeks with a possible feed conversion of 1.5. Birds will have more resistance against prevailing diseases.

Nutrition will supply feeds to attain the 1.5 feed conversion. Balance of amino acids will be improved. Fat will be increased economically. Feed formulae may be custom-made for different brands of birds. A part of the nutrients will be supplied in liquid form. Better additives will be found, and they may include hormones, enzymes and tranquilizers.

Vaccination against C.R.D. will be possible. Other diseases will develop which will make this part of production just as much a headache as it is now. Ventilation systems which work in most conditions will be found. Building materials will be improved, and this will reduce the cost of buildings per bird. Boned chickens and chicken rolls will increase the consumption of broilers. Frozen complete-meal dishes will increase in volume, and many of them will feature broiler meat. Total broiler consumption will rise as high as actual beef consumption.

More intelligent integration will enable the industry to coordinate the supply with the demand, and the prices will

not go below costs of production more often than they do usually with any of the large-volume commodities. Competition will be more a matter of quality of the birds than the fact of cutting prices.

The broiler industry will be recognized eventually as an important part of Canadian Agriculture, and its voice will be proportional to the important part it will play in the feeding of our population.

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THE VICTORIAN POULTRY IMPROVEMENT PLAN

B. E. BARTLETT

Department of Agriculture, Victoria, Australia

I. INTRODUCTION

Modern poultry breeding methods are now foremost in the popular interest of the commercial poultry industry throughout Australia. This interest and the progress being made by breeders is a direct result of the Poultry Improvement Plan. The plan was conceived following conferences from 1952 onwards and outlined in broad detail with recommendations in 1955.

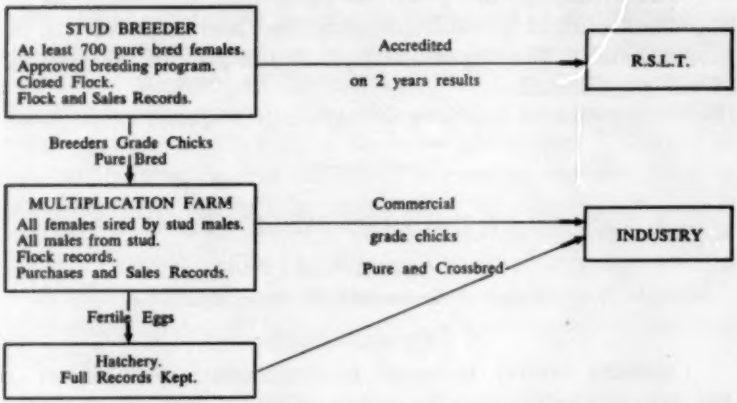
As the plan has now been in operation for a limited period this seems an appropriate time for all bodies concerned to re-examine the plan in the light of existing knowledge. Some questions that may well be asked are how much are we meeting the original aims of the Plan and do these aims need revising. Since they are an integral part of the Plan and, in fact, the basis for measuring progress, particular attention should be paid to the question of Random Sample Testing.

It is not proposed to enter into a lengthy discussion on these problems but rather to outline some examples in order to emphasise the need for a more detailed study. Victoria has been chosen because that is the State with which I am familiar and because there has been a close liaison with the C.S.I.R.O. regarding the implementation of the Plan in that State.

II. IMPLEMENTATION OF THE PLAN

The main aims of the National plan were briefly: to raise the efficiency of egg production by improving genotype and encourage multiplication of this improved stock, and secondly,

to protect both the genuine breeder and the poultry farmer from malpractice. The plan has been implemented in Victoria with a Departmental sponsored Accreditation scheme which may be illustrated diagramatically as follows:—



Advertising the Government's approval of a flock is limited to specific wording including the grade of chickens being sold, and evidence of falsifying records or indulging in improper or dishonest business practices can lead to disqualification. Participation in the scheme is voluntary.

In Victoria the first stud breeders will be accredited in approximately 14 months' time.

If properly carried out this scheme should fulfill the original aims of the Plan, and the scheme has been responsible for a big increase in interest in breeding by farmers who are adopting the sire family test.

III. THE RANDOM SAMPLE LAYING TEST

(a) Choice of Breeds

The effectiveness of their work in improving the genotype of stock sold to the industry depends mainly on the accuracy of results obtained in the Random Sample Laying Test, and also on whether this improvement is maintained in the multiplying stage either as purebreds or crossbreds. As yet there are no testing facilities for testing crossbreds or strain crosses in Victoria. It was anticipated at the outset of the scheme that interest would decrease amongst breeders releasing some facilities for this purpose. Also the general "nickability" of crosses between Australorps and White Leg-

horns was being relied upon. While this latter is probably true, the development of specialised table poultry breeds which is imminent will undoubtedly lower the carcass value of cull hens considerably.

When viewed in the light of rising feed prices the commercial emphasis for egg production may change to a smaller bird with a lower feed consumption. This may increase the interest in White Leghorns either as purebreds or strain crosses and the latter will certainly need testing.

(b) Method of Testing

The Random Sample Laying Test as at present constituted in Victoria allows for testing 44 entries. Each entry consists of 2 replicates of 20 pullets housed in deep litter pens. These 40 pullets are obtained by taking random samples of eggs from the competing farms and hatching and rearing at Burnley Gardens.

After the rearing period of 6 weeks during which time the chickens are randomised the birds are penned up in their replicate pens and feed consumption records commence. Adult mortality begins from the arbitrary point-of-lay period which has been fixed at 17 weeks. Eggs are graded to egg board standards on a sample basis of 12 days in each 28. All costs are based on an average of ruling commercial rates and receipts on net returns to producers. The test continues for 600 days, and takes in approximately 15 months' production.

(c) Problems of Testing

Some lessons have been learnt during the first test. Other problems have arisen and some of these cannot be answered until more tests have been completed. Further problems will need more detailed research, or may never be answered. These include cannibalism, disease, rate of lay, environmental influences and pen effects, and possible changes in official marketing policy.

(*i*) *Cannibalism* — This became quite marked in some pens. Debeaking was left until it had to be used as a control measure, as it was felt there may be some evidence that certain strains were suspect. However the effect of one addicted bird can be so damaging to an entry that in future tests all birds will be debeaked at 15 weeks as a precautionary measure. While this will undoubtedly mask any strain effect it is

thought to be in the best interests of competitors until more experimental evidence is available.

(*ii*) *Disease* — This is a serious problem. In both current tests a minor outbreak of caecal coccidiosis occurred. In the second test this happened despite the use of a preventative drug.

In each case isolated pens only were affected and in the second test one pen suffered trouble three times. Indications from the first test were that the disease had little effect on future performance but this observation must always be open to doubt. The exposure to most diseases is mainly a matter of chance, especially when general farm husbandry is good, but any resulting mortality plays a big part in the result of an entry. The answer is certainly that more birds are needed per entry to give a true picture of this important economic trait.

These extra birds should be included as further replicates to minimise pen effects on the sample averages of entries.

The only practical solution to this seems to be to raise the level of husbandry on commercial farms until it approaches that of Random Sample Tests. Such improvements in environment are invariably economically justified by increased production.

(*iii*) *Rate of Lay* — Some replicates gave completely different rates of lay. While the results of the two replicates are averaged and considered with results obtained in preceding years, again it seems more birds are necessary to increase the accuracy of the test.

(*iv*) *Environmental Influences* — When studying problems created by environmental influences both localised in pen effects, and in general, on an annual basis, the necessity of including a control flock in each test is realised. This control flock should be specifically propagated at random so that genotype remains as stable as possible. Then the year to year variations in such factors as climate, feed quality, management and presence of disease will be reflected in the performance of the control. Since so much depends on a control flock it may be necessary for the control to be of a larger sample than competing entries. Such a control is maintained by the C.S.I.R.O. at their Poultry Research Centre and has been included in the second Victorian Test.

(*v*) *Changes in Marketing Policy* — The final problem

stems from the possibility of the economic requirements of an efficient bird changing due to sudden changes in market policy. The only true yardstick of performance as far as the industry is concerned is the final figure on income over expenditure, and when measuring this, commercial costs and returns have to be used.

These costs, however, may be subject to sudden changes due to market conditions and policy. Seasonal feed prices, egg grade sizes and the price differential between grades may all fluctuate and any big change will disrupt the continuity of results from year to year. The official size for 1st Quality Large eggs in Victoria is 1¾ oz. but it is felt inadvisable to encourage breeders to produce flocks which lay eggs of this size.

At the time of writing consideration is being given to raising the size of the grade to 1⅞ oz. for Random Sample Test Purposes.

IV. CONCLUSION

In the development of the tests in Australia one of the suggested benefits was to be a free interchange of stock between States. This benefit will be seriously reduced by the lack of uniformity between the various tests. One possible means of overcoming this problem would be for all States to include a control group each year. This should preferably come from the C.S.I.R.O. to enable differences in averages to be evaluated. However, all States should also endeavour to make their tests as uniform as possible in all other respects.

In conclusion it will be noted that the Improvement Plan is very similar to the American System of large breeding farms and franchised hatcheries. The only difference is that breeding and testing of strains will be done by a group of individuals rather than on a single establishment. The ultimate selection of strains (i.e., flocks) for propagation being under the supervision of the Department by means of accreditation schemes.

The degree of success of the scheme will rely finally on the care and industry of all who participate.

(Presented at The 1959 Poultry Science Convention held in the University of Sydney, Australia, February 23-26, 1959)

CHECK LIST FOR EGG AND PULLET GROWING CONTRACTS

A check list of ideas to consider in examining egg and pullet growing contracts was drawn up at two recent Mid-West Regional Integration Conferences in the U. S. A.

QUESTIONS TO CONSIDER BEFORE SIGNING A PULLET OR EGG PRODUCTION CONTRACT:

1. *Is Period Covered by Contract a Specific Time or Date?*
2. *Is Renewal or Termination Automatic?*
3. *Cancellation—*
   a. What happens in case of death or illness, physical or mental, who determines?
   b. What happens in case of desire to sell?
   c. What happens in case of condemnation?
   d. What happens in case of Acts of God?
   e. What happens in case of unprofitable contracts?
   f. Is contract cancellable by *either* or both parties?
   g. Is contract cancellable for non-compliance?
4. *Identification of Parties:*
   a. Can contract be assigned to a third party?
   b. How is company (integrator) represented?
   c. Does wife have to sign along with the husband?
5. *What is the Legal Relationship of the Parties?*
   a. Joint venture
   b. Independent contractor
   c. Partnership
   d. Employee or agent?
   e. Creditor or debtor (is debt secured, if so how?)
   f. Landlord or tenant
6. *Legality of Contract:*
   a. Witnessed, notarized, recorded?
   b. Are signers authorized signers?
   c. Has this contract been checked by your lawyer?
7. *Arbitration:*
   a. What is procedure in the selection of an arbitrator?
   b. How many arbitrators?
   c. Is arbitration binding?
   d. Can arbitration be called for by either party?
   e. Who pays the cost of arbitration?
   f. When will arbitration be used?
8. *Non-Conformance:*
   a. What constitutes non-conformance?
   b. Can you go to court to fight non-conformance?
   c. What is the penalty for non-conformance?
9. *Payment Schedule:*
   a. How is it determined?
   b. When it it paid?
   c. Is it paid in cash?
   d. Is there a profit-sharing program? How figured, and is there likely to be any?
   e. When is bonus paid? (For high livability, good feed conversion, high egg production, etc.?)
10. *Who Supplies What? At What Price?*

A. *Supplies:*
1. Feed
2. Birds (age, strain)
3. Drugs, vaccines, and veterinary services
4. Litter
5. Housing
6. Equipment
7. Labor
*8. Nesting material
*9. Detergent sanitizer
*10. Shell oil
11. Supervision
12. Utilities (heat & light)
*13. Egg cases
14. Finances
15. Pick-up or deliver birds, feed, eggs.

B. *Insurance:*
1. Birds
2. Building
3. Equipment
4. Feed

C. *Who Owns?*
1. Manure
2. Feed bags
3. Egg cases
4. Eggs
5. Birds
6. Equipment
7. Housing

D. *Taxes—Who Pays?*
1. Real estate
2. Sales
3. Income
4. Personal property

11. *Management Questions: Which if Any of the Following Management Questions are Required?*
a. Feeding program
1. What is it?
2. Are home-grown grains allowed?
3. Can feed brands be shifted?
4. What feed additives will be used?
b. Must all birds on the farm be the same age, if not must different ages be kept separate?
c. What is the vaccination and or medication program?
d. What is the sanitation prorgam?
e. Water space, feeder space, housing space?
f. Debeaked (when)? Decombed? Dewinged?
g. Blood tested?
h. Type of housing?
i. Size of unit?
*j. Kind of est?
k. Housing arrangement (floor, cage, slat)?
l. Access of visitors to premises?
m. Replacement program and responsibility? When? How?
n. Who maintains the records, and are they complete? (Are they available to both parties)?
o. Is there supervision by qualified poultry fieldman?
p. Lighting schedule?
q. What cleaning methods, temperature, gathering, or egg handling methods in general are required?

12. *Marketing:*
a. How is price determined? (What does it mean)?
b. Who decides when to market?
c. Where do you market?
d. Are grades and standards specified?
e. Is there a market area specified?
f. Is carton, case or volume specified?
g. How is the specific grading or handling cost charged or paid?
h. Is grower required to furnish labor for moving birds?
i. Who salvages cull birds and who decides which are culls?
j. What happens in the case of undergrade or condemned eggs and/or birds?
k. Is there a limit on home consumption and selling at roadside?
l. What happens in case of excessive loss (death and/or egg quality)?

*Items so marked are in egg contracts only.

COST GUIDES FOR COMMERCIAL EGG PRODUCTION IN THE U. S. A. IN 1959

	Low	Medium	High
Housing costs range in cost per sq. ft.	$ .65	$ 1.50	$ 2.50
Equipment costs, per bird	.50	1.25	2.00
Started pullets at 16 weeks of age (cost to buy)	1.45	1.65	1.85
Pre-lay cost (16-24 wks—feed only)	.30	.30	.50
Hen housed production (eggs per year per hen housed)	200	225	250
Mortality during 12 months (7th to 18th month inclusive)	6%	12%	18%
Pounds of feed per doz. eggs (after 25% production)	4 lbs.	5 lbs.	6 lbs.
Cost of feed per ton (complete ration)	$60.00	$75.00	$90.00
Maintenance on house (per year original cost)	0.5%	1.0%	1.5%
Depreciation on house (per year original cost)	5%	7.5%	10%
Maintenance on equipment (per year original cost)	1%	1.5%	2.0%
Depreciation on equipment	10%	15%	20%
Interest, cost	4%	6%	8%
Taxes } Should be budgeted according	——	——	——
Utilities } to local condition	——	——	——
Insurance }	——	——	——

REVIEW OF POULTRY PUBLICATIONS

(*Abstracts from Animal Breeding Abstracts* and from *Nutrition Abstracts and Reviews* are reproduced by arrangement with the Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England.

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GENETICS

BAKER, R. C., and R. CURTISS. 1958. [New York State Coll. Agric., Cornell Univ., Ithaca.]
STRAIN DIFFERENCES IN EGG SHELL MOTTLING, INTERNAL QUALITY, SHELL THICKNESS, SPECIFIC GRAVITY, AND THE INTERRELATIONSHIPS BETWEEN THESE FACTORS. Poult. Sci., *37:* 1086-1090.—Twenty eggs from each of 20 pens of birds (7 pure strain S.C. White Leghorns, 8 S.C. W.L. strain crosses, 4 incrossbreds, and 1 crossbred) at the Central New York State Random Sample Test were collected for study. Correlations were calculated between the 4 egg characters. Highly significant positive coefficients of correlation were obtained between specific gravity and shell thickness. Specific gravity and shell thickness seemed to have little relationship with egg shell mottling. Internal quality was not significantly correlated with any of the other characters. There was a highly significant difference among the strains in all 4 factors.

CHAMPION, L. R., and K. G. ROOD. 1958. [Dep. Poult. Sci., Michigan State Univ. Agric. Exp. Sta., East Lansing.]
STUDIES IN HATCHABILITY. IV. F_5 GENERATION PERFORMANCE OF TWO STRAINS OF LEGHORNS IN PURE STRAIN AND STRAIN-CROSS MATINGS. *Quart. Bull. Mich. agric. Exp. Sta., 41:* 458-466.—Using 2 selected non-inbred strains of F_5 S.C. White Leghorns, matings were so arranged that pure strain and strain-cross chicks were produced concurrently. The results, which are tabulated, show that hatchability of fertile eggs increased in only one direction of the strain-cross. When previously reported data on earlier generations of the same strains are considered, differences in hatchability between generations are apparent.

DYRENDAHL, S. 1958. [Dep. Anim. Genet. Breed. Nutr. Hyg., Roy. Vet. Coll., Stockholm.]
HEREDITARY TREMOR IN DUCKS. *J. Hered., 49:* 214-216.—The affected ducklings were hatched in Sweden from eggs laid by sibmated ducks of crossbred origin. The muscular tremor, which affected the whole body and often made balance difficult, was apparent immediately upon hatching. It was so pronounced that the consumption of feed was greatly reduced or prevented entirely and most of the ducklings died of starvation during the 1st wk. of life. No abnormalities of the central nervous system could be detected at autopsy. As no cases of tremor appeared when carriers were mated with unrelated drakes it is concluded that the defect is due to a recessive autosomal gene in homozygous condition.—A.P.G.

[ENGLAND AND WALES]: MINISTRY OF AGRICULTURE, FISHERIES AND FOOD. 1959.
HYBRID CHICKENS. *Bull. Minist. Agric.* [*Lond.*], No. 180: iv+39 pp. Price: 2s. 6d.

FABER, H. v. 1959. [Zool. Inst. Landw. Hochsch. Stuttgart-Hohenheim.] Uber die hormalen Ursachen des Geschlechtsdimorphismus im Wachstum der Vogel.
ON THE HORMONAL CAUSES OF SEXUAL DIMORPHISM IN GROWTH IN BIRDS. *Verh. dtsch. zool. Ges.*, 1958 (*Zool. Anz.* Suppl. 22): 345-347. Discussion: 346-347.—Evidence is presented which indicates that, where sex dimorphism in body size exists, the larger sex (the ♂ in the Muscovy duck *(Cairina moschata)*, the ♀ in the sparrow-hawk *(Accipiter nisus nisus)*) has larger and more numerous acidophilic cells in the anterior pituitary than does the smaller sex. Hybrids betweeen the ♂ Muscovy and the ♀ Pekin duck (a breed which shows no marked sex difference in acidophils or in body size) were about the same weight in both sexes and there was no sex difference in the acidophils. In the reciprocal cross, however, the ♂♂ had larger and more numerous acidophils than the ♀♀ and were about twice as heavy. As the ♀♀ had very small ovaries containing follicles, whereas no ovarian follicles were present in ♀ hybrids sired by the ♂ Muscovy, it was thought that growth might have been inhibited by endogenous follicular hormone. However, relatively large doses of diethylstilbestrol (10-70 mg.) failed to inhibit growth in the ♀ hybrids that lacked follicles or in ♂ hybrids. In the case of the sparrow-hawk, treatment of 6 ♂ nestlings with 3 mg. oestradiol benzoate daily for 14 days failed to increase their growth. It is concluded that the sex difference in body size is not due to the effect of oestrogen.—A.P.G.

GLEICHAUF, R. 1958. [BundesforschAnst. Kleintierz., Celle.] Die Kopffleckbildung bei den Eintagskuken der Weissen Leghorn.
HEAD SPOT FORMATION IN DAY-OLD WHITE LEGHORN CHICKS. *Arch. Geflugelk., 22:* 157-169. [English summary.]—Variability of the occurrence of head spots in 15,361 day-old White Leghorn chicks from 8 different registered flocks in N.W. Germany was examined in 1956. It averaged 54.7% (35.2-74.4) and was probably genetically determined. Head spots occurred relatively more frequently in ♂ chicks on all farms than in ♀ chicks, and the difference was significant. When head spots were further subjectively divided into larger and smaller types, the sex difference for larger, more conspicuous ones in the ♂ was less, but still significant. Further analysis was necessary to determine whether one or several genes are involved. A small pilot experiment was held in the spring of 1957 with 6 hens (strain A) without head spots and 3 hens (strain B) with head spots. In strain A, among the F_1 progeny there were almost as many chicks with head spots as without (30 : 31), whereas in strain B, 32 out of 33 chicks had head spots.—S.E.C.

GLEICHAUF, R. 1958. Die Entwicklung von Zuchtstammen Kennfarbiger Italiener in Deutschland aus verschiedenen Ausgangsrassen.
THE DEVELOPMENT IN GERMANY OF STRAINS OF AUTOSEXING LEGHORNS FROM VARIOUS BREEDS—*Celler Jb.*, 1957 *(Kleintierz. Forsch. Lehre, 6):* 96-101. From *Geflugel-Borse, Westdtsch. Ausg.*, 1957, *78* (22): 2-3.—An account of German attempts to develop improved strains of autosexing Leghorns, particularly by means of crossing the German Blausperber and the White Leghorn with the Brown Leghorn.—A.P.G.

KIMBALL, E. 1958. [Clinton Exp. Farm, Conn.]
DOMINANCE AND EPISTASIS. *Poult. Sci., 37:* 1173-1174.—Controversial issues on the inheritance of the laced pattern in poultry plumage are raised.

KIMBALL, E. 1958.
WHITE-LACED RED PLUMAGE PATTERN. *Poult. Sci., 37:* 1174-1175.—The genetics of white-laced red and jubilee plumage pattern are discussed.

LOWRY, D. C., and **F. T. SHULTZ.** 1959. [Univ. California, Berkeley.]
TESTING ASSOCIATION OF METRIC TRAITS AND MARKER GENES. *Ann. hum. Genet.* [*Lond.*], *23* (2): 83-90.—An attempt was made "to determine the feasibility of certain methods for detecting linkage or any other type of association between individually identifiable genes and genes affecting metric traits." The metric traits investigated were part (1st Jan.) and full (1st Oct.) pullet egg production indices, sexual maturity, April egg weight, and shank length. These were studied in relation to blood group types. The proposed model assumed complete linkage between the locus or polygenic block affecting the metric trait and the test (blood group) locus. Of the 5 traits in 3 mating types studied, only sexual maturity in one mating type showed an interaction significant at the 0.05 level. However, as the number of available markers increases (which tends to be the case in blood group genes in poultry and other domestic animals) the possibility of detecting linkage for at least one of them is increased.

NORDSKOG, A. W., and **J. F. HILL.** 1958. [Iowa State Coll., Ames.]
CORRELATION BETWEEN EGG PRODUCTION AND ADULT VIABILITY IN HYBRID FLOCKS. *Poult. Sci., 37:* 1265-1273.—From a statistical analysis of field test comparisons of commercial chicken hybrid varieties, estimates of phenotypic and genetic population parameters for hen-day rate of egg production, hen-housed rate of egg production, and laying house viability were obtained. The data involved 31,019 pullets tested over a 4-yr. period. The phenotypic and genetic correlations between hen-day production and viability averaged 0.14 and 0.42, resp. Utilising the information supplied from the data a discriminant function selection index for egg production and viability was constructed. This index was shown to be 18% more efficient than the commonly used hen-housed production index.—Authors' summary.

TIERZUCHTER. 1959. Neue Huhnerrassen in Polen und China.
NEW POULTRY BREEDS IN POLAND AND CHINA. *Tierzuchter, 11:* 74. From *Agra Pr.*, 10/1/59.—Reference is made to a new autosexing breed of poultry developed in the Institute of Animal Breeding in Pulawy (Poland) called the Polbar, which is reputed to have extraordinary fertility and tender meat. Mention is also made of a new poultry breed at the Agricultural College in Changehun [?Changchun] with outstanding egg production.

PHYSIOLOGY

ALLEN, T. E., and **F. SKALLER.** 1958. [Poult. Res. Centre, Werribee, Vict.]
HIGH FERTILISING CAPACITY OF HIGHLY DILUTED FOWL SEMEN AND OBSERVED DIFFERENTIAL FERTILITY ATTRIBUTABLE TO BREED OR STRAIN OF DAM. *Poult. Sci., 37:* 1429-1435.—Fowl semen, diluted 10-13 times with Tyrode solution, when inseminated at the rate of 0.2 ml. twice weekly gave fertility results equal to those expected from undiluted semen or natural matings. Satisfactory fertility results (88%) were obtained when White Leghorn pullets were inseminated with the same volume of 13 times diluted semen only once weekly.

Up to 180 pullets were kept laying fertile eggs using the semen of 1 cockerel. The data indicate that if inseminations are made once weekly and the semen is diluted 10-13 times it would be possible to obtain high fertility by mating 1 cockerel to over 300 pullets. This would make possible the production of about 1200 paternal half-sibs of the same hatching date.

White Leghorn pullets gave higher fertility than Australorp

pullets when inseminated with semen of either White Leghorn or Australorp cockerels.—Authors' summary.

ATKINSON, J. C., K. R. BENNETT, and E. W. CALLENBACH. 1958. [Pennsylvania State Univ., State College.]
EFFECTS OF CERTAIN ENVIRONMENTAL FACTORS AND SEX ON POULT GROWTH WITH REFERENCE TO FUTURE EXPERIMENTAL DESIGN. *Poult. Sci., 37:* 1051-1054.

BARNES, ARTHUR E., and WALLACE N. JENSEN. (U. Pittsburgh Med. Sch.)
BLOOD VOLUME AND RED CELL CONCENTRATIONS IN THE NORMAL CHICK EMBRYO. Amer. Jour. Physiol. 197(2): 403-405. 1959.—A method for the determination of red cell mass, which employs the use of radioistopically-labeled erythrocytes, in the embryonated hen egg is described and results of total blood volume, plasma volume, red cell mass and red cell concentration determinations during the period from 9 to 18 days of incubation presented. Considerations of the values obtained in terms of absolute quantities and relative to embryonic mass are discussed. It is suggested that expansion of the red cell mass and somatic growth are portions of a common process and may be subject to a complex of similar regulatory factors in the normal chick embryo.—Auth. abst.

BREMER, H. (U. Gottingen, Germany. Das Dottergefasssystem beim Huhnchen als Beispeil einer Structur-Entwicklung.
THE VASCULAR NETWORK OF THE YOLK SAC OF THE CHICK EMBRYO AS AN EXAMPLE OF THE DEVELOPMENT OF STRUCTURE. Wilhelm Roux Arch. Entwicklungsmech. Organ. 150(6): 702-748. 1958.—The aim of this study was to clarify the factors governing the appearance of a capillary network on the yolk sac in the 3-19 segment chick embryo. Detailed examination accompanied by extensive mathematical analysis indicates that the average distance between the vessels is the factor governing the organization of the network.—F. Moog.

BRENEMAN, W. R., FRANK J. ZELLER, and BRUCE E. BEEKMAN. (Indiana U., Bloomington.)
GONADOTROPHIN ASSAY IN CHICKS. Poultry Sci., 38(1): 152-158. 1959.—White Leghorn cockerels were used for the assay of pregnant mare serum (PMS), follicle stimulating hormone (FSH), and luteinizing hormone(LH). The birds were given the hormone in 2 or 3 equally divided and spaced doses and were autopsied at 48 hours post-hatching. The increases in testis weight of treated chicks were calculated as percentage increases over the gonad weight of control animals and were plotted against the log-dose. Straight-line responses to PMS, FSH, and LH were noted when weight increases were plotted against log-dose. A minimum total dosage of 5.0 I.U. of PMS, 5.0 μg of FSH, and 50.0 μg of LH produced significant increases in testis weight when evaluated by the "t" test. The administration of LH in 2 injections was very effective but the responses were not as great as those produced when the same amount of hormone were given in 3 injections. Human chorionic gonadotropin (HCG) did not increase testis weight. There was no evidence of FSH augmentation by either the pituitary luteinizing hormone or by the HCG used in these experiments. The injection of FSH in combination with either LH or HCG actually was accompanied in most instances by increases in testis weight which were slightly less than the additive effect produced by the hormones when given alone. This was especially noteworthy when the highest dosages of FSH and LH were given—W. R. Breneman.

BRIAN, LUIGI. Aspetti costituzionalistici della sopravvivenza del sacco vitellino negli uccelli alla morte dell'embrione (Ricerche speri-

mentali sull'embrione di pollo.) I.
CONSTITUTIONAL ASPECTS OF THE SURVIVAL OF THE VITELINE SACK IN BIRDS AT DEATH OF THE EMBRYO (EXPERIMENTAL INVESTIGATIONS ON THE CHICK EMBRYO). I. Atti Accad. Ligure Sci. e Lettere 14: 194-202. Illus. 1958. [rec. 1959].

CAMPOS, AMADO CAMPANA. (U. Maryland, College Park.)
STUDIES ON THE INFLUENCE OF THE RATE OF CHANGES IN AMBIENT TEMPERATURE ON PRODUCTION TRAITS AND MORTALITY OF LAYING PULLETS. Dissertation Absts. 20(1): 11. 1959.

CARTER, R. D., M. G. McCARTNEY, V. D. CHAMBERLIN, and **J. W. WYNE.** 1958. [Ohio Agric. Exp. Sta., Wooster.]
MORE EFFICIENCY POSSIBLE IN ARTIFICIAL INSEMINATION OF TURKEYS. *Ohio Fm. Home Res., 43:* 87.—An experiment in which groups of 14 Large -type White turkey ♀♀ were inseminated during a 12-wk. period with varying amounts of undiluted semen at intervals of 2 or 3 wks. showed that eggs from hens inseminated with 1/100 ml. semen every 3 wks. did not differ significantly in seminal plasma replaced with an equal quantity of buffer. Fertility was not improved when the amount of diluted semen (1 to 10 or 1 to 20) inseminated was increased from 0.1 to 0.2 ml. Hatchability was unaffected by dilution.—Authors' summary.

COMMON, R. H., and **CHI-CHING MOK.**
PHOSVITIN IN THE SERUM OF THE HEN. Nature 183 (4678): 1812. 1959.

DURNICHENKO, E. D.
CONCERNING SEVERAL FORMS OF ERYTHROPOIESIS IN THE ALLANTOIS OF THE CHICKEN EMBRYO. Izv. Akad. Nauk. SSSR, Ser. Biol. 1955(2): 83-95. 1955.—The formation of new blood cells was studied on fixed preparations of allantois of chicken embryos. The author asserts that he observed the generation of blood cells from chromatin granules, "large-eyed calves" developing into cells within the maternal cell, hemocytoplast, and after their exit from it.—Transl. from Referat. Zhur. Biol. 35087, 1957, courtesy OTS-JPRS.

FARLEY, ROBERT EDWARD. (U. Washington, Seattle.)
CENTRAL NERVOUS SYSTEM FREQUENCY-DISCRIMINATION IN THE DOMESTIC HEN. Dissertation Absts. 19(12): 3379. 1959.

FRANTZ, W. L. 1958. [Dep. Zool. Ent., Ohio State Univ., Columbus.]
SOME FACTORS EFFECTING SPERMATOKINESIS IN THE TESTES OF THE HOUSE SPARROW *(Passer domesticus). Endocrinology, 63:* 507-516.—Measurements and histological studies were made on excised testes in fluids of different osmotic tonicity and on testes *in vivo* following injections of chorionic gonadotropin or epinephrine. Findings seem to support the conclusion that water absorption of a sufficient degree caused the rupture of Sertoli cells and the subsequent release of sperm.

GLEICHAUF, R. 1958. Bewirkt das Eintauchen von Bruteiern in Hormonlosungen eine vollkommene Geschlechtsumstimmung?
DOES THE IMMERSION OF INCUBATING EGGS IN HORMONE SOLUTIONS CAUSE A COMPLETE CHANGE OF SEX? *Celler Jb.*, 1957 *(Kleintierz. Forsch. Lehre, 6)*: 109-113. From *Dtsch. Kleintier-Zuchter, Ausg. Geflugel,* 1957, *66*(8): 5-6.—The findings of other workers on hormonal sex control do not confirm the claim made by a German firm that their product, Ger-Sex 56, is capable of bringing about complete sex reversal in the sense that a genetically ♂ embryo

will develop into a sexually normal egg-laying hen, although an effect similar to that of hormonal caponisation may be brought about. [*Cf. A.B.A., 26*, No. 1648.]

GLEICHAUF, R. 1958. Eine stummelflugelige Leghornhenne. A STUMPY-WINGED LEGHORN HEN. *Celler Jb.*, 1957 *(Kleintierz. Forsch. Lehre, 6)*: 102-109. From *Dtsch. Kleintier-Zuchter, Ausg. Geflugel*, 1957, *66*(35): 4-6.—A stumpy-winged Leghorn hen reared near Gifhorn, Germany, in 1956 is described. The hen, which was battery-reared, laid an egg weighing 50 g. on 30th Oct. 1956 and a further 16 eggs, averaging 54.8 g., during Nov. 1956. Thereafter it ceased laying and was found dead on 30th Dec. Death appeared to be caused by advanced leucosis of the liver and ovary. The wingfeathers were better developed on the left than on the right wing stump, although the right stump was considerably longer and stronger than the left. The ulna, radius, metacarpals and digits were missing in both wings, while the humerus was greatly reduced.

GUDKIN, A. F., D. N. MURUSIDZE, and I. A. SMIRNOV. 1959. [Agric. Inst., Blagoveshchensk, Bashkir A.S.S.R.] Primenenie uljtrafioletovyh lucei pri inkubacii jaic. THE USE OF ULTRAVIOLET RAYS IN INCUBATING EGGS. *Ptícevodstvo, 9*(2): 19-20.—At the Blagoveshchensk Hatchery 1500 eggs were subjected to ultraviolet rays for 1 min. [The number of treatments and the state of incubation at which they were given are not specified.] The hatchability of the treated eggs was 83.3% of eggs set and 87% of fertile eggs *v.* 73.6 and 77% resp. of 900 untreated control eggs. The hatching weight of the chicks in the experimental group was greater than in the control group.

JORDAN, KENNETH ALLAN. (Purdue U., Lafayette, Indiana.) MEASUREMENTS OF COMPONENT HEAT LOSSES OF POULTRY. Dissertation Absts. 20(1): 12-13. 1959.

KING, D. F. 1959. [Agric. Exp. Sta., Alabama Polytech. Inst., Auburn.] ARTIFICIAL LIGHT FOR GROWING AND LAYING BIRDS. Progr. Rep. Ser. Ala. Agric. Exp. Sta. No. 72: 4 pp.—An account is given of various experiments relating to the effects of light on egg production. When a flock of 120 White Leghorn pullets raised on 6 hrs. light daily was divided at 5 mths. into 4 equal groups receiving different weekly light increments, it was found that the number of eggs laid per mth. over a 15-mth. period was highest (336 eggs) in a group receiving small and infrequent light increases at the beginning of laying and larger and more frequent light increases as the laying period progressed. The daily light increase averaged about 18 mins. per wk. and varied from 0 at the start to as much as 45 mins. per wk. towards the end of the test period. Pullets receiving a regular light increase of 18 mins. per wk. averaged 330 eggs; those receiving an 8 min. increase 314 eggs; and those receiving a 28 min. increase, 311 eggs. As hens become older they apparently require greater stimulation in order to keep them laying at a high rate, and it suggested that birds be given a 3% increase in light each week. To provide a practical guide for determining this increase a light schedule calendar is given.

To determine the effect of a reduction in light on pullets, 3 groups of 30 Leghorns raised on 12 hrs. light daily were reduced to 6 hrs. of light per day when 4 mths., 5 mths., and 6 mths. of age resp. A group raised on 6 hrs. light per day was used as a control. All birds received light increases of 18 mins. per wk. throughout the laying period, starting at 5 mths. of age, except in the group that was reduced to 6 hrs. when 6 mths. old, where light increases started at 6 mths. As egg production was higher in the control group than in any of the experimental groups, it is concluded that birds raised on 12 hrs. light cannot be reduced to 6 hrs. without some loss in production. A suggested schedule

is, however, given for pullets raised under normal daylight.

In further experiments it was shown that light increases given weekly (14 mins.) were a little more stimulating than those given daily (2 mins.) or monthly (1 hr.). Pullets raised to 5 mths. on 6 hrs. light daily were somewhat superior in egg production to those raised on 12 hrs. light when both were transferred to a 14-hr. day during the laying period. In the case of pullets raised on 6 hrs. light, egg production was slightly higher in a group receiving a weekly increase of 18 mins. per day than in one subjected to a constant 14-hr. day during a 12-mth. laying period. Pullets raised on 6 hrs. light and a weekly increase of 18 mins. light averaged 270 eggs per bird per laying year compared with only 237 eggs for pullets raised on 12 hrs. light and supplied with 14 hrs. light during the laying period.—A.P.G.

KING, S. C., and W. H. KYLE. 1958. [North Centr. Reg. Poult. Breed. Lab., Purdue Univ., Lafayette, Ind.]

EFFECT OF SHIPMENT OF HATCHING EGGS ON FUTURE PERFORMANCE. *Poult. Sci., 37:* 1175-1177.—Batches of White Leghorn hatching eggs were sent by rail to 4 co-operating experiment stations and returned immediately, a 5-7 day round trip. They were then set, at 8-14 days old, along with controls which had been maintained at approx. 55° F. and 70% relative humidity. Shipment had no effect whatsoever on the subsequent laying house performance of the pullets hatched from these eggs.

KONEV, S. V. Estrogeny v zhivotnovodstve.

ESTROGENS IN LIVESTOCK RAISING. Nauka i Zhizn' 1958(3): 78-79. 1958.—Science has established that several organic synthetic substances: "stilbestrol", "dinestrol", "cinestrol", "gexostrol", etc., may have the same effect and at times even a more intensified effect, than natural hormones. These synthetic estrogens have been successfully used in fattening cattle, sheep and poultry.—OTS.

KORNFELD, WALTER. (U. Georgia, Athens, Georgia.)

ENDOCRINE INFLUENCES UPON THE GROWTH OF THE RUDIMENTARY GONAD OF FOWL. Anat. Rec. 130(4): 619-638. Illus. 1958.—Gonadal and pituitary growth have been studied in pullets and poulards. Rudiment size at 100 days of age was no larger when pullets were ovariectomized during the third week after hatching than when operations were performed on 45 day old birds. Ovariectomies performed on birds 60 or 75 days of age resulted in smaller compensatory gonads at the age of 100 days. Evidence presented suggests that the latent period from ovariectomy until onset of androgen secretion by the compensatory gonad is greatest when the ovary is removed from the very young bird. Comb growth was greater, regardless of rudiment size, in poulards ovariectomized during the third week of life than in any of the other groups. Pituitaries of poulards were heavier than those of pullets at 95 days and very small doses of ECP (estradiol cyclopentylpropionate) further increased their weight. The minimal subcutaneous dose of ECP (<2 μg per 100 gm of body weight per day) which inhibited rudiment hypertrophy in poulards ovariectomized at 12 to 21 days of age, had no significant effect upon either pituitary or oviduct weight. An adrogen-estrogen synergism for the inhibiton of testicular compensatory gonads was demonstrated. Attempts to stimulate growth of steroid inhibited gonads of poulards with PMS or avian gonadotropin were not successful.

MATSUDO, YOSHIO. (Fac. Agric., U. Miyazaki, Japan.)

THE RISE AND FALL OF THIAMINE IN HENS EGGS DURING INCUBATION. [In Japanese with English summ.] Bull Fac. Agric. Univ. Miyazaki 3(1/2): 110-113. Illus. 1958.—From the beginning to the end of incubation the ratio was 100:90.7 for nonfertile eggs, while for fertilized eggs the ratio was 100:3.8 or 100:1.9.—MDS.

TOTH, P., and J. BOGRE.
CHICK EMBRYO DEVELOPMENT. Agrartudomany 7(3): 132-135. 1955.—Following the principles of the Soviet biological control, the incubating station in Chortobad' obtained a duckling yield of over 80%. In Hungary, eggs are candled on the 6th day of incubation; in the USSR it is done on the 4th day. The 2d candling is done on the 11th day of incubation; it is recommended to candle eggs on the 19th day again. A plan for the diagnosis of nutritional defects and methods of incubation established by disturbance of normal embryo development, are proposed.—Transl. from Referat. Zhur. Biol. 72144, 1957, courtesy OTS-JPRS.

PADGETT, C. A., and W. D. IVEY. 1959. [Dep. Zool.-Ent., Alabama Polytech. Inst., Auburn.]
COTURNIX QUAIL AS A LABORATORY RESEARCH ANIMAL. *Science, 129:* 267-268.—Attention is drawn to some of the advantages of *Coturnix coturnix japonica* Temminck and Schlegel as a laboratory animal, especially for use in research on avian embryology and physiology.

QUICKE, G. V., and H. J. H. DE MUELENAERE. 1958. [Fac. Agric., Univ. Natal, Pietermaritzburg.]
STUDIES ON THE BIOCHEMISTRY OF COCK SEMEN. 3. DENSITY MEASUREMENTS OF SEMEN. *S. Afr. J. agric. Sci., 1:* 289-292. [Afrikaans and French summaries.]—No correlation was found between the optical density measurements and haemocytometer counts of 34 whole semen samples from 9 Black Australorp cocks. There was, however, a highly significant positive correlation for washed semen (28 samples), which suggests that there was contamination of semen during ejaculation. Besides giving more reproducible results the optical density measurement method is more time-saving.

SQUIBB, R. L. 1959. [Dep. Poult. Sci., State Univ. New Jersey, New Brunswick.]
RELATION OF DIURNAL TEMPERATURE AND HUMIDITY RANGES TO EGG PRODUCTION AND FEED EFFICIENCY OF NEW HAMPSHIRE HENS. *J. agric. Sci., 52:* 217-222.—The effect of environment on the production and size of eggs, feed efficiency and mortality of 144 New Hampshire hens, imported as chicks from the U.S.A., was studied simultaneously for 1 yr. in 5 areas of Guatemala in which temps. ranged from 0° to 45° C. and humidity was variable. The birds were housed in individual cages and received water and feed *ad lib.* Although the birds in the tropical lowlands did show signs of thermo-stress, there were no significant differences in egg sizes, production, feed consumption, mortality and body weight between areas or between groups within areas. The inconsistency of these data with other published reports is explained on the basis of the extremely wide diurnal ranges in temp. and humidity observed during the experiment. An attempt is made to present accepted physiological phenomena in the form of a working hypothesis wherein the diurnal temp. range is related to the fowl's tolerance to thermo-stress.

VAN HE-MINJ. 1959. Method prinuditeljnoi linjki pekinskih utok.
A METHOD OF COMPULSORY MOULT IN PEKIN DUCKS. *Pticevodstvo, 9(4):* 25-27.—The records of Chinese poultry breeders show that Pekin ducks begin laying at 150-160 days of age and produce an average of 200 eggs per year. The moult normally starts at the end of May and lasts 90-100 days. A method of management is described which enables the moult to be completed in 40-50 days; the ducks are housed with water and little or no food and the moult begins within a week, feathers being withdrawn as they become loose. The level of nutrition is increased as the moult progresses.

WILCOX, F. H., and C. S. SHAFFNER. 1958.
THE EFFECT OF DIFFERENT HANDLING METHODS AND ADDED FRUCTOSE ON THE FERTILIZING ABILITY OF CHICKEN SPERMATOZOA AFTER STORAGE. *Poult. Sci., 37:* 1353-1357.—The ♂♂ used were from a flightless strain being developed at the laboratory and a broiler-type strain, and the ♀♀ were White Leghorns in individual batteries. The following methods were used: (1) semen was diluted 1 : 10 with buffer and antibiotics followed by addition of sufficient buffer and antibiotics to give a tenfold dilution, and stored for 20-24 hrs. aerobically, (2) semen was diluted as in (1) but after storage was brought to original volume by centrifuging at 1200 R.C.F. for 10 mins. and adding fresh buffer without antibiotics (3 variations in storage), (3) semen was centrifuged as above before storage, the seminal plasma was discarded, and enough buffer with antibiotics was added to bring it to its original volume (also 3 variations), and (4) semen was dialysed with 50-100 times its volume of buffer and antibiotics. The effect on fertility and hatchability was compared along with undiluted samples used fresh or stored aerobically. Three trials were made and the results are tabulated. They provide evidence that cock semen can be stored for extended periods of time *in vitro*. Treatments (2) and (3) gave excellent fertility for semen. Other methods were less successful. There did not appear to be any difference between aerobic and anaerobic conditions, nor any effect between treatments on hatchability. In treatments (2)-(4) fertility was further increased by the addition of fructose just before insemination.

WILSON, W. O., and A. E. WOODARD. 1958. [Poult. Husb. Dep.. Univ. California, Davis.]
EGG PRODUCTION OF CHICKENS KEPT IN DARKNESS. *Poult. Sci., 37:* 1054-1057.—Two tests were made in which S.C. White Leghorn laying hens were kept in complete darkness in cages for 5 wks. Egg production was recorded for 5 wks. before the test, during, and for 5 wks. after the test. It dropped from 66 to 23% in the 4th wk. of the test and increased slightly during the last week. At the end of the test egg production was 23 and 21% in the 2 tests resp. Six hens that were out of production at the beginning of the test started to lay during the dark period. Those that paused for longer than 5 days laid at a rate of 60.2 and 77.1% in the 2 tests resp. Egg production declined most markedly in hens losing the largest percentage of body weight.

ZUCKER, H., J. C. ATKINSON, R. B. SCHNELL, and G. A. DONOVAN. 1958. [Chas. Pfizer & Co. Inc., Terre Haute, Ind.]
RELATIONSHIP OF VARIATION TO RATE OF GROWTH. *Poult. Sci., 37:* 1395-1400.—The relationship of rate of growth and variability was investigated using a total of 2208 pens of 3- and 4-wk-old New Hampshire chicks. A highly significant negative correlation between rate of growth and coefficient of variation was demonstrated.—From authors' summary.

NUTRITION

DAM, RICHARD. (Cornell U., Ithaca, N. Y.)
STUDIES ON ORGANIC UNIDENTIFIED GROWTH FACTORS REQUIRED BY THE CHICK. *Dissertation Abstr. 20*(1): 1-2. 1959.

DEGUTS, L. F.
SULFUR IN CHICKEN RATIONS. *Nauka i Peredov. Opyt v Sel'sk. Khoz. 1957*(2) : 24. 1957.—Addition of 0.5-3 g of natural gypsum to the daily ration of chickens affected with mange eliminated the condition and increased the egg laying capacity.—Transl. from Referat. Zhur. Biol. 2655, 1958, courtesy of OTS-JPRS.

DEMENTYEV, A. V., and V. P. DIKOV.
THE ADMINISTRATION OF POTASSIUM IODIDE TO CHICKENS. *Ptitsevodstvo 1957* (5) : 28. 1957.—An experimental group of chickens which received potassium iodide in a dosage of 20 mg per head, showed an acceleration of incubating and egg laying by 23% higher than the control group (which did not receive any potassium iodide). Administration of potassium iodide is recommended in chicken feed in regions where the soil, water and vegetation are poor in iodine compounds.—Transl. from Referat. Zhur. Biol. 2656, 1958, courtesy OTS-JPRS.

EYLES, D. E., and S. J. COWLISHAW.
SIMPLIFIED RATIONS FOR POULTRY AT PASTURE. *Empire Jour. Exptl. Agric. 27*(106): 158-169. Illus. 1959.—From experiments over 6 years it is concluded that a diet of wheat and minerals is adequate for growth of pullets even when grazing is restricted to that within fold units but that a protein supplement is necessary for high egg yields. During the summer months laying hens can also obtain appreciable quantities of carotene from young herbage.—From auth. summ.

FERRANDO, R., and J. KOENIG. Les matieres grasses dans les rations de croissance destinees aux Poulets.
LIPIDS IN FEEDS FOR HENS. *Rec. Med. Vet. Ecole d'Alfort 135*(1): 5-11. 1959.—Hens, 24 in 2 lots, were raised in battery, using both ordinary hens and those highly selected from stocks that appeared to utilize enriched feeds more efficientlv. A series of different feeds were used (both enriched and control) and the experiment conducted in 2 stages; increases in weight being determined at the end of 4 weeks and again after 9 weeks. "Economic indices", defined as the expense of producing a pound of live meat were computed. Results are presented for selected enriched diets and for a series of experiments. The authors conclude that following the use of enriched feeds (4-6% lipids) the index of consumption is lowered about 6% and the growth rate raised by 5-17%, when feed protein content is 21-24%, especially for selected strains. Profitability is marginal, however, because lipids are expensive. Thus, careful consideration of all economic factors is necessary before deciding on their use.—MDS.

JENSEN, LEO STANLEY, JOHN BYRON ALLRED, RAMON EUGENE FRY, and JAMES McGINNIS. (State Coll. Washington, Pullman.)
EVIDENCE FOR AN UNIDENTIFIED FACTOR NECESSARY FOR MAXIMUM EGG WEIGHT IN CHICKENS. *J. Nutrition 65*(2): 219-234. 1958.—Evidence was obtained that an unidentified factor present in yellow corn and in certain other feedstuffs is necessary for maximum egg weight, egg production and hatchability of fertile eggs in the chicken. Feeding of graded levels of corn showed that a dietary level of 70% of the sample used was necessary to obtain the maximum effect. Dehydrated grass was not a good source of the factor. Several fractions of corn were tested and the factor was found to be concentrated in crude corn oil. A level of 3% of crude corn oil was as effective as 70% of corn in raising egg weight, whereas 3% of animal tallow was ineffective. A deficiency of the unidentified factor affected the quantitative deposition of yolk rather than the deposition of albumen or shell. Depostion of cholesterol in the yolks of the eggs was not affected by the presence of concentrated sources of the unidentified factor.

McCULLY, K. A., W. A. MAW, and R. H. COMMON. (Macdonald Coll., Quebec, Canada.)
OBSERVATIONS ON THE MINERAL METABOLISM OF PULLETS. XII. THE EFFECTS OF PROTRACTED TREATMENT WITH ESTROGEN AND WITH ESTROGEN PLUS ANDROGEN ON RETENTION OF SODIUM. *Canadian Jour. Animal Sci. 39*(1):

1-5. 1959.—The course of sodium retention by sexually immature crossbred pullets treated with 0.5 mgm. estradiol benzoate (ODB) per day or with 0.5 mgm. ODB plus 0.4 mgm. testosterone propionate (TST) per day did not differ significantly from the course of sodium retention by untreated control pullets. The average daily retention by the pullets from 11 to 15 weeks of age was 37 mgm. Na per day.—Auth. abst.

NESHEIM, MALDEN CHARLES. (Cornell U., Ithaca, N. Y.)
STUDIES ON THE EFFECT OF SELENIUM AND OTHER FACTORS ON VITAMIN E DEFICIENCY IN THE CHICK. *Dissertation Absts. 20*(1): 13-14. 1959.

PAINE, CLAIR MAYNARD. (Rutgers U., New Brunswick, New Jersey.)
INTESTINAL ABSORPTION OF METHIONINE AND HISTIDINE BY THE CHICKEN. *Dissertation Absts. 20*(1): 62. 1959.

RANIT, G. O. (U. Philippines, Los Banos.)
A NUTRITIONAL EVALUATION OF SOME RATIONS FOR GROWING CHICKS. *Philippine Agric. 42*(2/3): 39-48. 1958.—Four different rations based largely on available domestic feeds were fed to New Hampshire and White Leghorn chicks, and weight gains recorded at 12 weeks. Nutrient and amino acid compositions were calculated for all rations. The response of chicks varied significantly according to the nutrient quality and composition of the rations. The ration whose nutrient composition was nearly equal to that recommended by the National Research Council (U.S.A.) produced the heaviest birds and highest feed conversion (3.1 kg feed for 1 kg gain) at 3 months of age.

RANIT, G. O., R. Z. ORGIGAS, and **M. M. YLAGAN.** (U. Philippines, Los Banos.)
THE EFFECT OF SUPPLEMENTING ANTIOXIDANT IONOL-CP (2-6-DITERTIARY-BUTYL-P-CRESOL) TO A BROODING RATION FOR CHICKS. *Philippine Agric. 42*(4): 134-140. 1958.—Significant improvement in growth was obtained for Single-Comb White Leghorn chicks fed a practical ration supplemented with 25 mg of Ionol-CP (2, 6-di-tertiary-butyl-p-cresol) as an antioxidant. Increasing the level of the antioxidant caused a gradual decrease in growth rate but a gradual increase in the vitamin A content of the liver. Regression coefficients showed that an increase of 1 mg of Ionol-CP per 100 g of feed decreased cockerel and pullet weights by 0.519 and 0.497 g respectively but increased the vitamin A stored in the liver of males by 0.271 International Units per g of liver.—J. L. Brewbaker.

RICHARDSON, CHARLES EDWARD. (Louisiana State U., Baton Rouge.)
THE EFFECT OF DIETARY PROTEIN AND ENERGY LEVEL UPON THE NITROGEN COMPONENTS IN THE URINE OF THE DOMESTIC HEN. Dissertation Absts. 19(12): 3114. 1959.

RIGDON, R. H., G. CRASS, T. M. FERGUSON, and **J. R. COUCH.**
EFFECTS OF GOSSYPOL IN YOUNG CHICKENS WITH THE PRODUCTION OF A CEROID-LIKE PIGMENT. *Arch. Pathol. 65*(2): 228-235. Illus. 1958.—Chickens fed gossypol develop a hemolytic type of anemia and have a ceroid-like pigment deposited in duodenal villi and in sinusoids of liver and spleen. No significant pathologic changes were observed in the viscera of gossypol-fed birds. It is suggested that the pigment is produced from an effect of gossypol on the erythrocytes.—MDS.

TAYLOR, T. G., and **J. H. MOORE.** (U. Reading, England.)
THE EFFECT OF HIGH AND LOW LEVELS OF DIETARY INORGANIC PHOSPHATE ON THE PRE-LAYING STORAGE OF CALCIUM AND PHOPHORUS AND ON COMPOSITION OF THE

MEDULLARY AND CORTICAL BONE IN PULLETS. *Brit. Nutrition 12*(1) : 35-42. 1958.—Before a pullet begins to lay, a new system of secondary bone is laid down, which provides a highly labile reserve of minerals for formation of the egg-shell. When high (1.88 g P/day) and low (0.75 g P/day) P rations were fed to birds which were killed immediately after laying their first eggs, the mean Ca:P ratios of mineral stored were 1.66 and 2.30 respectively. Calculations showed that the low-P birds were unable to retain enough P from their ration to allow development of the medullary bone and the reproductive organs. The deficiency was probably compensated by P supplied from the cortical bone, and the soft tissues other than the liver. Dietary P supplementation apparently made little difference in the composition of the cortical bone, but the medullary bone from birds getting the high-P ration was higher in P and lower in CO_2 and citrate.—J. E. Oldfield.

TISNA-AMIDJAJA, D. A. (Zool. Inst., Bandung, Java.) Wachstumsbeeinflussung durch Acetylcholin, Alloxan, Nadisan, Aristamid, Nicotinsaureamid und p-Aminobenzoesaure beim Huhner-embryo.

EFFECTS OF ACETYLCHOLINE, ALLOZAN, NADISAN, ARISTAMIDE, NICOTINAMIDE, AND P-AMINOBENZOIC ACID ON THE GROWTH OF CHICK EMBRYOS. *Wilhelm Roux Arch. Entwicklungsmech Organ. 150*(6): 655-658. 1958.—The substances under investigation were injected into the air sacs of White Leghorn or Partridge-feathered Italian embryos at 2 or 3 days. Acetylcholine elevates both fresh and dry weight, relative to that of the controls, especially at 12 and 16 days. Histamine also elevated fresh and dry weight, and the effects are additive with those of acetylcholine. Alloxan increases fresh and dry weight, the effect being maximal (10-15% above the controls) between 12-14 days. The blood sugar content is higher than normal. None of these 3 substances interferes with normal development, but nadisan (N_1-sulfanyl-N_3-n-butylcarbamide) retards development and causes abnormalities of limb, beak, and feather formation. It also reduces blood sugar. Aristamid (6-sulfanilamido-2,4-dimethylpyrimidine) also causes similar abnormalities, and reduce fresh and dry weight. Nicotinamide and p-aminobenzoid acid elevate fresh and dry weight. The former tends to counteract the effects of aristamide. With the exception of 1 series, the number of embryos used is not stated. The quantitative differences reported are small, and they are not shown in any series to be significant.—F. Moog.

VITAMINS AND HORMONES. 1958.

VITAMINS AND HORMONES. ADVANCES IN RESEARCH AND APPLICATIONS. Vol. 16. Edited by R. S. Harris, G. F. Marrian and K. V. Thimann. *New York: Academic Press, Inc.* xi+437 pp. [B.] Price: 93s.

PATHOLOGY

BURMESTER, B. R., W. G. WALTER, M. ADRIAN GROSS, and A. K. FONTES. (U. S. Dept. Agric., Animal Husbandry Res. Div., East Lansing, Michigan.)

THE ONCOGENIC SPECTRUM OF TWO "PURE" STRAINS OF AVIAN LEUKOSIS. *Jour. Natl. Cancer Inst. 23*(2): 277-291. 1959.—Under experimental conditions conducive to full expression of their pathogenic properties, 2 "pure" strains of avian leukosis were studied. Six experiments involving 3178 chickens were performed. Cell-free preparations of erythroblastosis strain R (Beard) caused visceral lymphomatosis in a high percentage of birds that survived the erythroblastosis. Similar cell-free preparations of the myeloblastosis strain A (Beard) caused myeloblastosis, visceral lymphomatosis, renal adenocarcinomas, and osteopetrosis. All combinations except myeloblastosis-visceral lymphomatosis were observed. Infectious levels were found

in the oral washings and extracts of droppings (fecal-urinary) from chickens that showed signs of leukosis after intravenous inoculation of plasma from chickens with leukosis strain R and from others with leukosis strain A. Virus was also found in similar collections from non-inoculated chickens that showed no evidence of disease, and were reared in contact with others inoculated with strain R. The virus of leukosis strain R and strain A was transmitted by bird-to-bird contact; the former produced erythroblastosis and visceral lymphomatosis, and the latter, visceral lymphomatosis, osteopetrosis, and renal adenocarcinomas in noninoculated pen mates.—Auth. summ.

SILLER, W. G. 1958. [Agric. Res. Coun. Poult. Res. Centre, Edinburgh.] VENTRICULAR SEPTAL DEFECTS IN THE FOWL. *J. Path. Bact., 76:* 431-440.—Ventricular septal defects were studied in inbred and crossbred lines of Brown Leghorns. A genetical aetiology is suggested. Of 613 birds examined 288 were affected and of these 97% belonged to 3 lines. The incidence of the defect was 84.2% in the S line and nil in F_1 progeny of reciprocal crosses of line B in which incidence was 5.9% and line I in which it was 5%; it was extremely low in high ×high and in high×low crosses.

MANAGEMENT

BARNETT, B. D., E. C. NABER, J. B. COOPER, and C. L. MORGAN. 1958. [Poult. Dep., South Carolina Agric. Exp. Sta., Clemson.] INFLUENCE OF RANGE AND CONFINEMENT REARING OF TURKEYS ON GROWTH, FEED CONSUMPTION AND BODY CONFORMATION. *Poult. Sci., 37:* 1304-1308.—When Broad Breasted Bronze and Small Type White turkeys were reared on range from 8 to 24 wks. of age the percentage with broad breasts was greater than among those reared in confinement, but there were no differences in growth, feed efficiency, or mortality.

GENERAL

MEHNER, A., and O. WOINOFF. 1958. Die Huhnerhaltung in der Bundesrepublik Deutschland. Eine statistische Analyse. THE REARING OF POULTRY IN THE GERMAN FEDERAL REPUBLIC. A STATISTICAL ANALYSIS. *Celler Jb.,* 1957 *(Kleintierz, Forsch. Lehre, 6):* 25-38. From *Dtsch. WirtschGeflugelz.,* 1958, *10:* 17-20; 38-40.—Tables are given showing the following data for 1955 and 1956: the percentage of West Germans from town and country areas that keep domestic poultry, the number of fowls per km.^{2} in each type of district, the number per head of the population, the number per poultry breeder, and the percentage of young birds in the total hen population in different areas.

AGRICULTURAL INSTITUTE REVIEW. OTTAWA. 1959. CANADA'S NEW LOOK IN POULTRY. *Agric. Inst. Rev.* [*Ottawa*], *14*(2): 9-68.—The whole of this issue is devoted to the poultry industry in Canada. Poultry production in Canada is being put increasingly on a business basis, and there is a steady increase in commercial poultry units at the expense of farm flocks. Briefly, broiler fowls have reduced the market for heavy roasters, the rapid increase in turkey broiler production in 1958 is causing the turkey industry to reassess its breeding and production programmes, and there was a record number of eggs produced, breeders turning to the smaller, egg-type birds for better feed efficiency. Papers on the following subjects are included: the poultry breeding and hatchery industry by A. S. Johnson, egg production by F. G. Proudfoot, broiler production by R. P. Poirier, turkey production by P. A. Kondra, and research by J. Biely.

WORLD'S POULTRY SCIENCE ASSOCIATION

FINANCIAL STATEMENT

January 1, 1959, to December 31, 1959

	Dr. Jaap	*Major Macdougall* £	*s*	*d*
Balance January 1, 1959		1,019	4	11
Transfer from Dr. Heuser	$ 2,631.48			
Receipts				
Memberships	4,194.15	2,291	0	1
Advertising	1,455.62	13	7	9
Subscriptions	690.97	1	7	0
Back issues and congress reports	88.28			
Transfer from savings account	2,362.23			
Transfer from Major Macdougall	2,803.75			
TOTAL	$11,595.00	2,305	14	10
Expenditures				
Printing and mailing Journal	$ 6,748.74			
Clerical and administrative	945.60	400	0	0
Postage, telephone, telegrams, etc.	314.08	48	6	2
Supplies (stationery, etc.)	150.65	37	2	6
Abstracts	16.00	12	12	0
Translations		8	8	0
Commonwealth Agricultural Bureaux		299	0	0
Editor	600.00			
Associate Editor	275.00			
Travel expenses		171	19	2
Rebate to branches		340	6	8
Sundry expenses	13.48	6	0	10
Transfer to treasurer		1,001	6	3
TOTAL	$ 9,063.55	2,325	1	7
Balance December 31, 1959	$ 5,162.93	999	18	2
Savings Account Balance December 31, 1959	$20,690.18			
Credit - Suspense A/c		1	0	0
Credit - Tel-Aviv Bank (Israeli £s)	181.440			

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Ministerium für Ernährung, Landwirtschaft und Forsten, Rossstrasse 135, Düsseldorf

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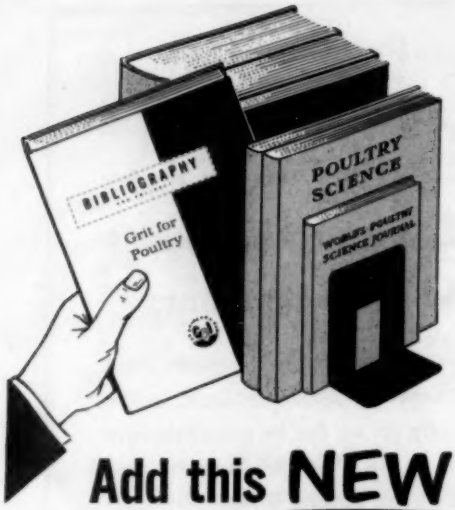

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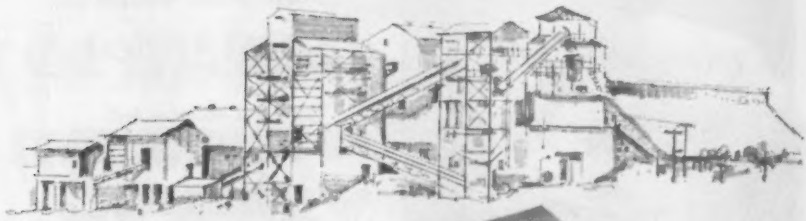

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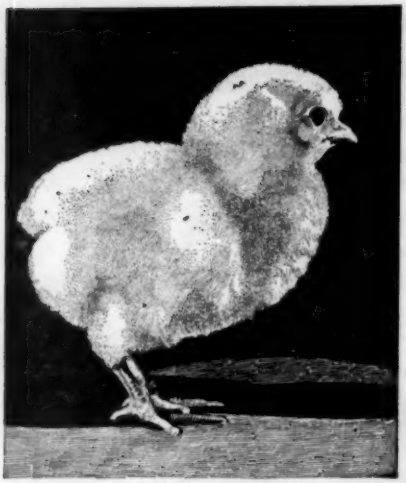

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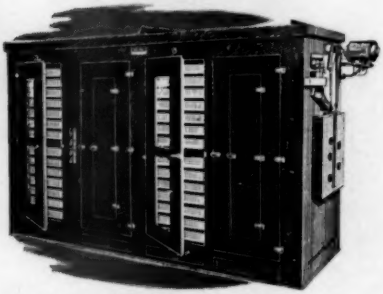

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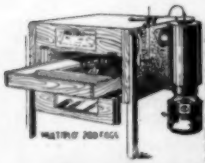

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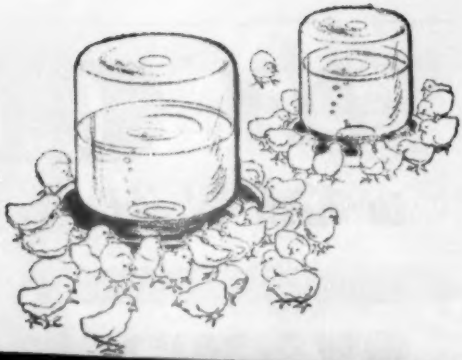

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